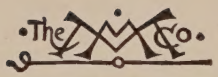
Alta Cox.
Little Bill (The Lully)

MATERIA MEDICA FOR NURSES



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MATERIA MEDICA FOR NURSES

BY

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In Memoriam

TO MY FATHER

WHOSE PATERNAL LOVE AND SYMPATHY HAVE
BEEN A CONSTANT INSPIRATION TO
THE AUTHOR
THIS BOOK IS AFFECTIONATELY DEDICATED.

PREFACE TO THIRD REVISED EDITION

The experience of the World War has not only added many new substances to our therapeutic armamentarium, but it has changed our methods of using old remedies and developed new points of view. This rapid progress of both medicine and nursing and the desire to keep the book abreast of the times have created a demand for a new edition of this book whose previous editions and their numerous reprints were so cordially and gratefully received.

The object of this edition is merely to add the changes dictated by the progress of the sciences directly or indirectly related to the use of drugs, and to include the new substances in common use. There is no departure from the original plan of the book, which is to teach the facts about drugs that are of practical value to the nurse, in an inductive manner. To accomplish this object we must utilize the facts that the nurse gains in her practical experience, adding thereto those that cannot be obtained at the bedside, but always emphasizing the nurse's practical point of view. By combining the facts derived from both these sources we can develop clear practical concepts about the use of drugs.

Owing to the World War numerous substances that were formerly a foreign manufacture are now made in the United States under a different name; for example, Novocaine is also called Procaine, Veronal is Barbital, Salvarsan is now called Arsphenamine, Diarsenol, etc. These substances are described in the text under both names.

Perhaps our most important medical heritage of the World War is the Carrel Dakin method of treating wounds. Dakin's solution and its numerous preparations have therefore been described in detail. Optochin, Papaverine and Benzyl Benzoate, new substances which are extensively used, have also been added.

The chapter on Organic Remedies has been entirely rewritten and enlarged, to keep pace with the growing importance of these substances in modern therapeutics. In describing them I have

departed, however, from the method followed in the rest of the book, because the subject is still in its infancy and I have attempted to scrupulously adhere to the known facts about these substances. The text on sodium bicarbonate and magnesium sulphate has been enlarged to conform to the broader therapeutic use of these substances.

I desire to express my sincere thanks to the many friends in both nursing and medical professions for the helpful suggestions and the kindly interest shown in the previous editions. Finally, I wish to express my appreciation to my publishers for their painstaking efforts in bringing out this edition under very trying circumstances.

A. S. Blumgarten.

PREFACE TO SECOND REVISED EDITION

The recent advances in Pharmacology, Physiology and allied subjects have created a demand for a new edition of this book, whose first edition, and its many reprints, was tendered such a cordial and gratifying reception. This made it necessary to reset the book, which has given me the opportunity to incorporate many additions and changes which are dictated by the progress of medicine and nursing, and by my further experience in the use of the inductive method in teaching nurses in a number of institutions of various types. In these I have found the inductive method to be singularly adapted to the development of the essential skill in the nurse's highly important, yet purely passive function in the use of remedies. It was according to this method that the first edition of this book was written, with the aim of developing clear, interesting word pictures of the effects of drugs and of correlating the class study with the nurse's actual observation and practical work.

Perhaps the branch of Materia Medica most important to the nurse is the Administration of Medicines; yet, "mirabile dictu," this is the most neglected branch. An attempt is made in the chapter on the "Administration of Medicines" to place this subject on a definite, scientific and practical basis. A large part of this subject-matter appeared in a series of articles in the "American Journal of Nursing" during 1914 and 1915. In offering this chapter I am cognizant of the fact that we are far from the millennium in our knowledge of Materia Medica and Pharmacology, or any other live natural science. Life and the philosophy of its phenomena are subject to constant change. Nevertheless, I have utilized the known scientific facts as a basis for formulating rational and uniform methods of administration.

The chapters on "Solutions" and the "Preparation of Doses" have been simplified and elaborated. The type prob-

lems have been illustrated by means of numerous diagrams, a method which I have found to be very helpful in teaching solutions. A summary and numerous problems have been added to these chapters to overcome the frequent difficulty in obtaining a broad general survey of solutions after the methods for their calculation and preparation have been mastered.

While the classification of the drugs follows the same general plan of Stimulants and Depressants, the drugs are more closely grouped around the organs they principally affect.

The position of caffeine and alcohol in the classification has been changed to conform to the more recent pharmacological conceptions. The chapters on serums, vaccines and organic remedies have been grouped with the specifics to conform to the therapeutic classification. The relation of digitalis action to the newer ideas on the physiology of the heart has also been added. The same visual method has been followed under the action of the drugs, but additions and changes have been made for the sake of clearness wherever these seemed to be indicated.

A few newer drugs have been added; no old drugs have been omitted; all the unimportant and infrequently used substances have been condensed. An appendix on "The Harrison Law" and its practical application to hospital nursing has also been added.

I desire to express my sincere thanks to the many friends throughout the country, in both the nursing and medical professions, whose kindly interest in my small efforts has served as a gratifying stimulant. Finally, especial thanks are due Drs. Norbert Stadtmueller and Walter J. Heimann for helpful suggestions; to Miss Adele S. Poston and Miss Mildred Seigler for their kind assistance in the tedious work of proof reading; and to my publishers for the pains they have taken with the many technical details.

A. S. Blumgarten.

PREFACE

The modern nurse is no longer merely the gentle attendant at the sick bed, able to perform only a few practical duties, but she is now also a watchful trained observer; of symptoms of disease, of the development of complications, and of the effects of drugs and their poisonous symptoms. In this capacity, and because of her constant presence at the bedside, she is of inestimable value to the physician in the management of the complex and often treacherous phenomena of disease.

The object of this text book is to develop intelligent, trained observers of the effects of drugs and to enable the nurse to administer medicines accurately. The majority of text books for nurses are entirely too technical, with the result that the nurse learns a great many technical terms without gaining a clear idea of the changes that drugs produce in the functions of the human body. An attempt is therefore made to present the subject in a strictly pedagogic manner, to teach facts, not words, and always to proceed from the known to the unknown. The new matter presented is based throughout upon facts previously explained. The pharmacological action is arranged in a simple, concise manner to facilitate the remembrance of the text. The numerous tables scattered throughout the book are intended to correlate the facts already learned; for example, a table of Cardiac Stimulants follows the discussion of the drugs in this group; a table of comparative actions follows that of the Atropine group, etc.

It is also essential that, before taking up the changes which drugs produce in the action of the body, the nurse have some idea of the normal action of the body. For this reason there have been scattered through the text numerous notes on Normal Physiology wherever it was felt to be necessary to a clear understanding of the drugs presented, since the arrangement of the curriculum in most training schools is such that Physiology is often studied at a later time than Materia Medica.

The nurse has ample opportunity, in the wards, to observe the effects of drugs on actual patients; but she does not benefit from this opportunity because her observation is untrained. It is to

assist and train her observation that the descriptions of the "Appearance of the Patient" are inserted in the text. These enable the nurse to compare the effects of a particular drug, given to an individual patient, with the standard description of that drug as given in the text.

Little attention is given to therapeutics; as the nurse should never treat, but administer and observe. It is occasionally important, however, that in administering certain potent drugs she should have some idea of the reason for such administration, to aid her in the observation of their effects. Short notes on the use of some of the important drugs are therefore inserted.

The chapter on "Solutions" deals with this very important subject at great length, because the proper and accurate administration of drugs, and the preparation of accurate solutions, is of prime importance to the nurse. Most of the rules for the calculation of solutions given in the text are entirely original and have been found in actual practice to be the easiest and simplest. This chapter also contains many helpful tables, such as "Saturation Points," "Usual Strengths of Standard Solutions," etc.

This book is perhaps larger than many texts on this subject but this is due to the inclusion in the text of the following features usually not dealt with: the chapter on "Solutions"; the chapter on "Prescription Reading," a subject required by most State Boards; and particularly by the inclusion, among the preparations, of most of the "New and Non-Official Remedies" in common use. Many of these substances are extensively used, and it is the nurse who has to administer them. Where is she to find the action and preparations of these drugs if not in her text book?

The classification of the drugs is based upon their therapeutic use since the nurse learns their action in this way. They are arranged in two distinct groups: "Stimulants" and "Depressants," and then according to the particular organs of the body they principally affect.

I desire to express my sincere thanks to Dr. Richard Stein and Dr. Norbert Stadtmueller for their careful examination of the proofs; and to Miss Anna L. Schulze, R. N., former Superintendent, and Miss Elizabeth P. Lindheimer, R. N., the present Superintendent of the German Hospital Training School for Nurses, New York, for valuable suggestions.

I avail myself of the opportunity to acknowledge the use, as references, of the following works: "Pharmacology and Therapeutics," by A. R. Cushny; "Therapeutics, Its Principles and

Practice," by H. C. Wood; "Essentials of Materia Medica and Therapeutics," by Henry Morris; "New and Non-Official Remedies," 1913 edition, of the American Medical Association; and to notes on the Lectures on Pharmacology delivered by Dr. W. A. Bastedo at the College of Physicians and Surgeons (Columbia University), New York.

A. S. Blumgarten.

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MATERIA MEDICA FOR NURSES

MATERIA MEDICA FOR NURSES

PART I.—PHARMACY, CLASSIFICATION AND ADMINISTRATION

CHAPTER I

INTRODUCTION

Materia Medica is the study of the substances used in treating the sick. Most of these substances are drugs; many of them, however, are serums, solutions of bacteria, or extracts of organs. The subject may be divided into three distinct branches:

Materia Medica proper, or **pharmacognosy,** which deals with the botanical, chemical and physical properties of drugs.

Pharmacology or **pharmacodynamics,** which is the study of the action, or the effects of drugs; that is, the study of the changes which drugs produce in the activities of the body, or of its organs.

Therapeutics, which deals with the treatment of disease.

For the nurse, only the first two branches of Materia Medica are of importance, as she is never called upon to treat patients, nor should she ever do so without orders from a physician. She should know, however, the properties and effects of drugs, for the physician relies upon her to see that their desirable effects are obtained, and that no unusual or poisonous symptoms occur. When these symptoms do occur, she should be able to recognize them as early as possible.

SOURCE OF DRUGS

Drugs are obtained from the mineral, vegetable, and animal kingdoms. The drugs obtained from the vegetable

kingdom are made from various parts of plants, such as the roots, the bark, the flowers, the fruit or the sap; and in some instances from the entire plant.

From the crude plant, various preparations are made, so as to be able to regulate the strength, or to measure the dose of the drug more accurately; in some instances to make the drug more palatable, or to disguise its unpleasant taste.

PHARMACEUTICAL PREPARATIONS

The preparations of drugs are made by either physical or chemical means. In the preparations made by purely physical means the drug itself is not changed. The substance is merely ground up and prepared in some special form, or dissolved in a fluid such as water, alcohol, etc. Preparations made in this way are frequently called Galenicals, because they were used extensively by Galen, a great physician who lived several centuries ago.

The chemical preparations are those made by decomposing the drug so as to obtain some of the active substances. The active principles of drugs, such as alkaloids and glucosides, are prepared in this way.

PHYSICAL PREPARATIONS

SOLID SUBSTANCES

For Internal Use

	Common name	*Latin name*
Concentrated Preparation	Extract	Extractum
	Powder	Pulvis
	Pill	Pilula
	Capsule	Capsula
	Tablet	Tabella
	Cachet	Cachet
	Lozenge	Trochiscus
	Vescette	Vescette
	Confection	Confectio
	Sterule	Sterula
	Paper	Charta

For External Use

Common name	*Latin name*
Ointment	Unguentum
Cerate	Ceratum
Plaster	Emplastrum
Suppository	Suppositorium
Lamella	Lamella

DEFINITIONS OF SOLID PREPARATIONS

For Internal Use

Concentrated Preparation

Extracts are solid preparations obtained by dissolving the drug in alcohol or water, and then evaporating the solution. The resulting sediment is the extract, and is usually about four or five times as strong as the crude drug itself.

Physical Preparations of Various Forms

Powders are crude drugs ground up into a powder and used in this form.

Pills are drugs moulded in the form of a very small sphere. They should always be fresh, for when they are exposed to the air they may become so hard that they cannot be dissolved by the juices of the stomach or intestine, and will then produce no effects.

Capsules are drugs made up into a small cylindrical gelatin container which disguises the taste of the contained substance.

Tablets are dried powdered drugs which have been compressed into small discs. They are usually prepared in an aseptic manner so that they can be given hypodermically. Tablets are very easily dissolved.

Cachets are small disc-like pieces of rice paper which are stuck together, enclosing between them the drug to be administered.

Lozenges are flat discs consisting of a drug made up with sugar or tragacanth or any demulcent substance.

Vescettes are effervescent salts compressed into a tablet.

Confections are preparations of drugs made up to disguise the taste of unpleasant tasting substances. They are usually made up with honey and sugar.

Sterules are glass capsules containing a sterile solution of a drug. They are used for hypodermic administration.

Papers are small pieces of paper impregnated with medicinal substances.

For External Use

Ointments are preparations which are usually made up with lard, vaseline, or oils. They are applied to the skin and are melted by the heat of the body and the drugs are then absorbed.

Cerates are preparations of drugs made up with white wax.

Plasters are preparations which are made up with resins, wax or lead plaster, and spread upon coarse muslin or white leather. They are applied to the skin, the mixture of the drugs which they contain is dissolved by the heat of the body, and the drugs are then absorbed.

Suppositories are cone-shaped preparations of a drug made up with cocoa butter.

Lamellae are small gelatin discs containing medicinal substances, which are inserted between the lower eyelid and the eyeball.

FLUID PREPARATIONS

The fluid preparations may be divided into the following two groups:

(a) **Concentrated Preparations:** These are made by dissolving the drug in a fluid in which some of the extraneous matter is not soluble. The resulting fluid contains the drug in a more concentrated form and is therefore more active.

(b) **Solutions:** Fluids in which the entire drug is dissolved.

Concentrated Preparations

Common name	*Latin name*
Fluidextract	Fluidextractum
Tincture	Tinctura
Infusion	Infusum
Decoction	Decoctum
Wine	Vinum
Oleoresin	Oleoresina

Solutions

In water		In alcohol	
Common name	*Latin name*	*Common name*	*Latin name*
Water	Aqua		
Solution	Liquor	Spirit	Spiritus
Mucilage	Mucilago		

In sugar		In vinegar	
Syrup	Syrupus	Vinegar	Acetum
Elixir	Elixir	**In glycerine**	
		Glycerite	Glyceritum

Suspensions

(Undissolved)

Common name	*Latin name*
Emulsion	Emulsum
Mixture	Mistura

Special Methods of Preparation

Oleate	Oleatum
Liniment	Linimentum

DEFINITIONS OF FLUID PREPARATIONS

Concentrated Preparations

Fluidextracts are concentrated fluid preparations of drugs made by dissolving the crude plant drug in the fluid in which it dissolves most readily. The strength and character of the fluid used therefore varies with each drug, and may be 95% alcohol, alcohol and glycerin, or dilute alcohol of various strengths. Fluidextracts, however, are always 100% in strength; that is, m. i. contains gr. i and 1.0 c.c. contains 1.0 gm. of drug.

Tinctures are dilute alcoholic extracts of drugs varying in strength from 10 to 20%. The Pharmacopoeias of all countries now agree on 10% as the standard strength for tinctures of all powerful drugs. Tinctures of weak drugs are often 20% in strength. Tincture of iodine and tincture of iron chloride, which are not extracts, are alcoholic solutions and not real tinctures. When another fluid besides alco-

hol is contained in the tincture this is added to the name; for example, when the alcohol contains ammonia, the tincture is called an ammoniated tincture.

Infusions are preparations of plant drugs made by pouring hot or cold water over them, and then allowing the drug to steep. The strength of an infusion depends on the quantity of drug used to a definite amount of water.

Decoctions are preparations of plant drugs made by boiling them in water and then straining the fluid.

Wines are preparations of drugs dissolved in wine. They are made like the tinctures but have a better flavor.

Oleoresins are extracts of plant drugs made by dissolving the crude drug in acetone. They contain the resinous substance and oils of the plant.

Solutions

In Water

Waters are solutions of substances which evaporate very easily.

Solutions are drugs dissoved in water. Solutions usually contain substances which do not evaporate easily.

Mucilages are gummy drugs dissolved in water.

In Alcohol

Spirits are preparations of volatile substances dissolved in alcohol.

In Sugar

Syrups are preparations of drugs made with sugar and water.

Elixirs are palatable preparations of drugs. They are made up with alcohol, sugar and some aromatic substance. They usually contain very small quantities of the drug.

Solutions in Other Fluids

Vinegars are medicinal substances dissolved in a weak solution of acetic acid, or vinegar.

Glycerites are preparations of drugs dissolved in glycerine.

Oleates are medicinal substances dissolved in oleic acid, which is an ingredient of many oils and fats. Oleates are more easily absorbed than ointments.

Liniments are liquid or soft preparations of drugs which are applied by rubbing on the skin. The drug is usually dissolved in alcohol or in an oily substance.

Suspensions

In the following preparations the drug is contained in the fluid in fine particles:

Mixtures are preparations consisting of several drugs mixed together. Fluids containing a substance which does not dissolve are also called mixtures.

Emulsions are solutions of oily substances which contain the oil divided up into fine globules. They are usually of a milky color and consistency.

OFFICIAL AND UNOFFICIAL PREPARATIONS

Official Preparations

In order that all drugs shall be uniformly prepared, and standards maintained for the strengths of the different preparations, a committee of physicians and pharmacists is appointed in every country to regulate the strengths and methods of preparation of all the drugs used in medical practice. This committee publishes a book known as the Pharmacopoeia, which contains a list of all the preparations of drugs whose ingredients, strengths and methods of preparation conform to a certain standard. Such preparations are called **official preparations,** and often have the letters, U. S. P. (United States Pharmacopoeia), B. P. (British Pharmacopoeia), etc., written after them. Some preparations may be official in one country and not in another, though they may be used in both countries.

Unofficial Preparations

Since the Pharmacopoeia committee revises the Pharmacopoeia only once in ten years, many drugs and preparations, are discovered in the meantime which are not listed. Many

of these substances may be extensively used during that time, though they are not described in the Pharmacopoeia. These drugs are called **unofficial preparations.** Some of these unofficial preparations may be subsequently accepted by the Pharmacopoeia committee as conforming to its standards in strength, ingredients and action, and they then become **official preparations.**

Other unofficial preparations may not be accepted by the Pharmacopoeia committee at all, though they may be extensively used.

The United States Dispensatory is a private unofficial book containing a list of both official and unofficial preparations, their ingredients, preparations, and their methods of preparation. The National Formulary contains a list of the unofficial substances and their methods of preparation.

To keep pace with the new drugs that are constantly being discovered, The American Medical Association publishes annually a book of "New and Non Official Remedies" which contains a list of the new drugs that have proved to be valuable and efficient. These remedies are often distinguished by the letters N. N. R. placed after them.

ACTIVE PRINCIPLES

It was formerly thought that certain plants cured disease because of magic or supernatural powers which they possessed; and unless certain formalities were complied with in obtaining these drugs, they were not supposed to have any curative effect.

For example, in obtaining the drug hyoscyamus (henbane) it was necessary that the drug be dug up with certain precautions, and addressed as follows:

"Sacred herb, I summon thee to the house (of my patient) to stop the Rheum of his feet, etc. I conjure thee by the great name Jaoth Sabaoth." We now know that this drug has certain active principles (the alkaloids, atropine, hyoscyamine, hyoscine) which are responsible for its effects.

In gathering other drugs the following formula was used: "Delve round the root and take it up with thy two hands

turned upward; sing over it nine paternosters, and in the ninth, at the words 'Deliver us from evil' snap it up," etc. Frequently it was necessary to mention the name of the sick man and his father, etc., etc.

We now know, however, that all drugs cause changes in the activity of the body by virtue of certain chemical substances which they contain.

These substances which are contained in the crude plant are called **active principles.** When they are extracted from the plant they produce the same but more reliable effects as the crude drug itself. Nearly all the active principles belong to the following groups of chemical substances:

1. **Plant or Organic Acids**
2. **Alkaloids**
3. **Glucosides**
4. **Saponins**
5. **Oils**
6. **Tannins**
7. **Resins**
8. **Oleoresins**
9. **Balsams**

Plant acids: Many of the fruits contain organic acids (acids containing carbon), thus lemons contain citric acid, grapes, tartaric acid, etc.

Alkaloids: An alkaloid is an active principle, found in plant drugs or made chemically, which acts like an alkali. (An alkali is a chemical substance which combines with acids to form salts. It turns red litmus paper blue). Alkaloids also combine with acids to form salts, which have the same effects as the alkaloids themselves. For example, when sodium, an alkali, is added to sulphuric acid, a salt, **sodium sulphate,** is formed. When morphine, an alkaloid, is added to sulphuric acid, a salt, **morphine sulphate,** is formed.

Chemically, alkaloids consist largely of carbon, hydrogen and nitrogen.

The alkaloids do not dissolve readily in water, but their salts are very soluble and are the preparations principally used.

The alkaloids and their salts form a precipitate when tannic acid or potassium permanganate is added to them, but this precipitate is not soluble and is therefore not absorbed, thus making the alkaloids inactive. For this reason tannic acid or potassium permanganate are used as antidotes in cases of poisoning by any of the alkaloids.

The names of all the alkaloids end in "**ine.**"

Glucosides are active principles of plant drugs which always form a sugar (usually glucose, or grape sugar, hence the name), when decomposed by acids, heat, bacteria or other agents. They are neutral substances, because chemically, they are neither acids nor alkalies. The names of all glucosides usually end in "**in.**"

Saponins: These are glucosides which have some of the properties of soap; that is, they foam when mixed with water. They are found in a number of plants such as sarsaparilla, quillaja bark, etc. They are not absorbed, but merely act locally by injuring the tissues with which they come in contact (irritating). When given internally they cause nausea, vomiting and diarrhoea. Many drugs produce these effects because of the saponins which they contain.

Oils: These are substances which have a characteristic greasy feel and with whose physical characteristics the reader is no doubt familiar. Chemically they consist of a mixture of three substances: olein, stearin and palmitin, the three elementary fats. Each of these substances consists in turn of a fatty acid (complex organic acid) combined with glycerin. Oils are of two kinds: **fixed and volatile.**

Fixed oils comprise most of the oils in common use, such as olive, cottonseed and castor oil. The fixed oils do not evaporate easily. They are decomposed in the intestine by the digestive juices into a fatty acid and glycerin. The rancidity of fats and oils is due to a similar decomposition by heat.

The oils are utilized as foods, and medicinally they are very soothing substances. Many oils, however, such as castor oil and croton oil, when decomposed in the intestines form fatty acids which act as drugs.

Volatile or essential oils are oils which evaporate very readily. They usually have a very pleasant aroma which gives the pleasant odor to the plants from which they are obtained. The most common volatile oils are oil of wintergreen, oil of peppermint, oil of camphor, etc. When a volatile oil is allowed to stand for some time, some of its constituents evaporate, leaving a thick film which is called a **stearoptene.**

Tannins: These are substances whose chemical composition has not yet been determined, but they seem to be acids. They are found in the bark of many trees, in witch hazel and other plants. They form insoluble precipitates with alkaloids and proteins, and are therefore used principally as astringents.

Resins: These are thick sticky substances which form the sap of many trees. Most of these substances can be dissolved in alcohol but not in water. Some resins are solid; for example, the rosin used by violinists.

Oleoresins: These are substances found in many plants which consist of a resin combined with a volatile oil. They are usually prepared by dissolving the crude plant in ether.

Balsams: These are resins or oleoresins which contain benzoic or cinnamic acid.

Enzymes or Ferments: These are the active principles of many animal and vegetable substances which are capable of producing very definite effects. The chemical composition of these substances is unknown but they are destroyed by moist heat of a temperature of about 60°C. The best known enzymes are *pepsin,* the active principle of gastric juice, *trypsin,* one of the active ferments of pancreatic juice, *sinalbin,* the active ferment of white mustard and *sinigrin,* the ferment of black mustard. Myrosin and emulsin are ferments which are found in the seeds of various plants. Since enzymes are destroyed by heat, preparations which depend upon ferments for their effects should not be given in hot liquids.

Hormones: These are the active principles of various glands in the body such as the thyroid, the pituitary, the

spleen or the adrenal glands. These glands secrete these active elements into the blood stream which then have a profound influence on the growth, development and metabolism of the individual. Only very few of these specific hormones have as yet been isolated. Adrenalin is one of the hormones of the adrenal gland. Pituitrin is one of the hormones of the pituitary gland.

TYPES OF DRUG ACTION

Any drug may cause either **local or general effects.**

Local effects result from the direct application of a drug to a tissue or organ. The drug combines with the albumins of their cells forming an albuminate. If this albuminate does not readily dissolve in the surrounding fluids it protects the cells from further action of the drug. Such an effect is called an **astringent action.** If the albuminate is readily dissolved in the surrounding fluid, more of the drug combines with the cells until they may be completely destroyed. Such an effect is called **irritation.** Substances like caustic soda produce such effects.

General or **systemic effects** are the effects that result from the action of a drug upon an organ or tissue remote from the site of application. To produce a general effect a drug must circulate in the blood stream.

The process whereby a drug enters the blood stream is called **absorption.** The process whereby a drug is eliminated from the body is called **excretion.** A drug may be injected directly into the blood or find its way into the blood from the subcutaneous tissues or from the stomach or intestines. When the drug enters the blood stream the effects upon the cells will result from one of the following actions:

Physical action, Chemical action or Salt action

Physical Action: This is an action of a drug that results when some of the constituents of a cell are temporarily dissolved in a fluid drug which is brought to the cell by the blood stream. When the drug is eliminated from the body the cell constituents become normal again and the effects

pass off. For example, the effect of ether on the brain is believed to be due to the fact that the ether dissolves out some of the constituents of many of the brain cells, thus modifying their function and producing unconsciousness and insensibility to pain.

Chemical Action: This is the way in which most drugs probably produce their effects. They probably cause a chemical combination of the drug with some of the constituents of the cells of one or of a number of organs. We do not yet know the nature of this chemical combination, but we do know in the case of most drugs where these changes occur.

Salt Action: Salts, sugars, acids and alkalies act in a distinctive manner. This type of action is manifested especially by salts and is therefore called "salt action."

When salts or any of these substances enter the stomach or intestine they withdraw fluid from the blood and tissues thus diluting them. This process is called **osmosis,** and occurs whenever two salt solutions of a different concentration are separated by an animal membrane.

When the salt has been thoroughly diluted by the fluid withdrawn from the tissues, part of it is then absorbed. Some salts, however, are very slowly absorbed and others not at all. The absorbed salt now circulates in the blood stream until it reaches the various cells of the body in the lymph with which these cells are constantly bathed. If this lymph now contains a **greater** percentage of salt than the cell, water is withdrawn from the cell. On the other hand, if the percentage of salt in the surrounding lymph is **less** than that in the cells, the cells absorb water from the lymph. This process is called **diffusion;** it differs from osmosis since it occurs without the intervention of an animal membrane. The activity of the cells of some organs such as those of the kidney may thus be made more active by a number of salts.

Selective Action: No drug affects all the organs or tissues of the body. The ability of a drug to affect only certain organs or tissues is called **selective action.** Thus strychnine usually acts only upon the cells of the spinal cord, morphine upon the cells of the brain, etc.

Synergistic Action: This is the ability of a drug to aid the effect of another.

Antagonistic Action: This is the ability of a drug to antagonize the effect of another.

Therapeutic Action: This is the effect a drug produces in diseased conditions.

Physiological Action: This is the effect a drug has on a normal animal.

Side Actions are the effects that result from a drug other than those desired.

Empiric Action: This is the effect that has followed the use of a medicine in disease but which has not been corroborated by laboratory experiments.

Poisonous or Toxicological Action: This is the effect that results from an overdose of a drug.

IDIOSYNCRASY OR UNTOWARD EFFECT

Some individuals get unusual, opposite, even poisonous effects from ordinary doses of certain drugs. Occasionally even large doses of certain drugs produce no appreciable effects. Such effects are called **idiosyncrasies or untoward effects.** They occur in two forms:

(a) **Idiosyncrasy of Effect:** This is a condition when small or ordinary doses of a drug cause no effects, unusual, opposite or poisonous effects. For example, morphine is a drug which usually produces sleep and quiets the patient. In some individuals it causes excitement and wakefulness.

(b) **Idiosyncrasy of Dose:** This is a condition where even large doses of a drug cause no effects at all.

CUMULATIVE ACTION

Some drugs are excreted much more slowly than they are absorbed. If such drugs are administered for any length of time, a part of each dose always remains in the body. After prolonged administration so much of the drug may accumulate in the body that poisonous effects may occur. The poisonous effects that result from a drug accumulating in the

body as a result of the elimination being slower than the absorption are called **cumulative effects.**

Drugs which are apt to cause cumulative effects when given continuously, should be administered with periods of intermission during which the drug is stopped, or the dose should be gradually reduced. For example, digitalis, which may cause cumulative effects, should be given in diminishing doses or with periods of intermission when it is discontinued entirely.

CLASSIFICATION

All drugs affect the body, or an organ of the body, by either **increasing or lessening** its activity.

A drug which increases the activity of the body, or any of its organs, is called a **stimulant;** the act of increasing the activity is called **stimulation.**

A substance which lessens the activity of the body, or any of its organs, is called a **depressant;** the act of lessening the activity is called **depression.**

When the activity of an organ is increased to such an extent that it is overacting, it is said to be **overstimulated.**

A substance which injures the cells of a tissue or organ is called an **irritant;** the effect of such a substance is called **irritation.**

The effects produced by overstimulation may be those of lessened activity or **depression;** since, by overacting, an organ may become exhausted. For example, the poisonous effects of some drugs, which ordinarily increase the activity of the body, may be those of lessened activity.

A poisonous substance is injurious to the body by causing great overactivity of one or several organs of the body (irritation), or by greatly lessening the activity (depression).

Most drugs **increase or lessen** the activity only of **one or a number** of organs of the body.

We can classify all drugs, therefore, according to the effect produced on the activity of the body, or on any of its organs (stimulation or depression), and according to the organs they principally affect, or for which they have a selective action.

CLASSIFICATION OF DRUGS

(Only the most important drugs are here given)

STIMULANTS	DEPRESSANTS
Increasing activity	Lessening activity

Drugs Acting on Gastro Intestinal Tract

The Stomach

To replace active substances

Acids

Hydrochloric acid.
Sulphuric acid
Nitric acid

Digestants

Pepsin.
Pancreatin

To neutralize acid

Alkalies

Sodium. } Salts
Potassium. } Salts
Ammonium. } Salts
Calcium } Salts
Magnesium } Salts

Bitters

Gentian.	Calumba
Serpentaria.	Berberis
Capsicum	Cardamom.
Cinchona.	Ginger

Emetics

Ipecac.	Apomorphine.

Intestinal Tract

Cathartics

Cascara.	Mineral Oil.
Agar Agar	Castor Oil.
Senna.	Rhubarb
Aloes.	Licorice
Phenolphthalein	Podophyllum.
Euonymus	Scammony
Croton Oil.	Colocynth
Gamboge	Jalap.
Elaterium.	

Anthelmintics

Drugs which Destroy Worms

For Tape Worm

Aspidium	Kamala
Cusso	Granatum
Pepo	Pelletierine.

STIMULANTS	DEPRESSANTS
For Round Worm	
Santonin.	
Spigelia	
Chenopodium	
For Thread Worm	
Quassia.	
(Alum)	
For Hook Worm	
Thymol.	
Naphthol	
(Calomel).	
Chenopodium	

Drugs which Affect the Blood and Blood Forming Organs

Iron.
Arsenic.
Calcium Lactate

Drugs which Affect the Heart

Digitalis Group.	Aconite.
Strophantus	Veratrum Viride.
Convallaria	(Eserine)
Squills	(Pilocarpine)
Strychnine.	
Atropine (Belladonna Group).	
Camphor	
(Caffeine)	
Ammonia.	

Drugs which Affect the Blood Vessels

Epinephrine.	Amyl Nitrite.
Pituitary Extract.	Nitroglycerine
(Ergotoxine)	(Nitrite Group)

Drugs which Affect the Respiration

(Atropine).	(Opium and Morphine).
(Caffeine)	(Chloroform).
(Strychnine).	(Chloral)
(Camphor)	(Aconite)
	(Dilute Hydrocyanic Acid)

NOTE: Parentheses around the name of a substance mean that the effect under which it is grouped is not its principal effect.

STIMULANTS	DEPRESSANTS

Drugs which Affect the Nervous System

The Brain

Caffeine.
(Coca)
(Atropine).

Bromides.
Alcohol.

To Relieve Pain

Analgesics

Opium and Morphine.
Cannabis Indica
Acetanilid. } Act also as Antipyretics
Antipyrine } Act also as Antipyretics
Phenacetine. } Act also as Antipyretics
Pyramidon } Act also as Antipyretics
and similar unofficial products

To produce anaesthesia

Chloroform.
Ether.
Ethyl Chloride.
Nitrous Oxide.

To Produce Sleep

Hypnotics

Chloral Group
Trional.
Tetronal
Veronal.
Sulphonal
Paraldehyde
Chloretone
Hypnal
and other similar substances

Spinal Cord

Strychnine.

STIMULANTS	DEPRESSANTS

Drugs Acting on the Nerve Endings

Sensory Nerves

Local Anaesthetics

Cocaine and derivatives.
Menthol
Anaesthesin
Orthoform
Hydrocyanic acid

Efferent Nerves

Drugs Acting on the Secretory Glands

Pilocarpine.	(Atropine).
(Eserine)	(Camphor)
(Ipecac)	

Drugs Acting on the Involuntary Muscles

Eserine or Physostigmine.	Atropine.
	Gelsemium
	Lobelia

Drugs Acting on the Kidneys

Diuretics

Caffeine.
Theobromine
Diuretin.
Agurin
Potassium Acetate.
Potassium Citrate
Potassium Bitatarate
Potassium Nitrate.
Sodium Acetate
Sodium Nitrate
(Digitalis Group).
Mercury (Calomel and Blue Pill)

STIMULANTS	DEPRESSANTS

Drugs Acting on the Genital Organs

Ergot.
Hydrastis (Hydrastinine)
Pituitary Extract.
Rue
Tansy
Savine
(Quinine)

Viburnum.

Specifics

Drugs which Cure Particular Diseases (Usually by Destroying the Cause)

For Malaria

Quinine.
(Arsenic)

For Syphilis

Mercury.
Salvarsan.
Iodides

For Rheumatism

Sodium Salicylate.
Salicylic Acid
Salicin
Salol
Aspirin.
and their derivatives

For Gout

Colchicum.
Atophan

For Amoebic Dysentery

Emetine.

Serums, Antitoxins, and Vaccines

Antistreptococcus Serum
Antipneumococcus Serum
Diphtheria Antitoxin
Tetanus Antitoxin
Tuberculin
Staphylococcus Vaccine
Streptococcus Vaccine
Smallpox Vaccine
Bulgaric Bacilli Preparations
Dunbar's Serum
Pollen Vaccine

Organic Substances

Drugs Obtained from Various Organs of Animals

Thyroid Extracts
(Pituitary Extracts)
Ovarian Extracts
(Epinephrine)

Drugs which Act on the Skin and Mucous Membranes

Astringents

(Drugs which Contract Tissues and Check Secretions of Mucous Membranes)

Metals		Vegetable Substances
Lead		Tannic Acid
Copper		Gallic Acid
Zinc		Tannigen
Aluminium	Salts	Tannalbin and similar substances
Silver		
Bismuth		
Barium		

Antiseptics

Drugs which Check the Growth of Bacteria

Carbolic Acid.
Creolin.
Lysol.
Sulphur Dioxide
Calcium Chloride
Bichloride of Mercury.
Potassium Permanganate.
Hydrogen Peroxide.
Boric Acid.
Formalin.
Iodoform
Eucalyptus
Ichthyol.
Urotropin.
Salol
Naphthol
Thymol.
Copaiba
Cubebs
and numerous other similar substances

Counterirritants

Rubefacients

Drugs which Cause Redness of the Skin

Mustard.
Turpentine.
Arnica
and other similar substances

Vesicants

Drugs which Produce Blisters

Cantharides.
(Mustard)

Pustulants

Croton Oil.
Tartar Emetic

Caustics

Drugs which are Used to Destroy Tissues

Mineral Acids
Glacial Acetic Acid
Caustic Potash.
Caustic Soda.
and strong solutions of the metallic astringents

Demulcents and Emollients

Drugs which Soften and Protect the Skin or Mucous Membrane

Vaseline.
Cocoa Butter.
Olive Oil.
Lanolin
Glycerin,
Starch
Flaxseed.
Acacia
and other mucilaginous substances

Miscellaneous Substances

Flavoring Substances

Peppermint.
Spearmint.
Saccharin, etc.

CLASSIFICATION OF EFFECTS

Special names are given to drugs causing certain effects. The following is a list of definitions of the names given to groups of drugs according to their most important effects:

Absorbents are substances which increase the absorption of diseased tissue.

Alteratives are drugs whose mode of action is unknown, but which improve the nutrition of the tissues, and help to absorb diseased tissues, thereby restoring them to their normal condition.

Anaesthetics are drugs which produce insensibility to pain.

Local Anaesthetics are drugs which produce insensibility to pain at the site of application.

General Anaesthetics are drugs which produce insensibility to pain all over the body. These drugs also produce unconsciousness.

Analeptics are substances which bring about health and strength.

Analgesics are drugs which relieve pain when absorbed into the blood.

Anodynes are drugs which relieve pain when applied locally. They are usually milder in action than the analgesics.

Antacids are drugs which neutralize acids. They are usually given to neutralize the acid in the stomach.

Antiemetics are drugs which check vomiting.

Anthelmintics are drugs which destroy or expel worms.

Antiarthritics are drugs which relieve gout.

Antilithics are drugs which prevent the formation of stones.

Antiperiodics are drugs which relieve regular attacks of chills and fever, as in malaria.

Antipyretics are drugs which reduce fever.

Antiseptics are substances which check the growth of bacteria.

Antisialogogues are drugs which check the flow of saliva.

Antispasmodics are drugs which lessen contractions of muscles, and also lessen convulsions. The term is also applied to drugs which lessen nervousness, because of the tremors of the muscles which often occur in these conditions.

Antizymotics are drugs which check the action of germs.

Aperients are substances which produce mild movements of the bowels.

Aromatics are spicy substances which increase the secretion of the stomach and intestines.

Astringents are drugs which contract or harden tissues.

Bitters are drugs which increase the appetite because of their bitter taste. They also increase the flow of gastric juice.

Cardiac Stimulants are drugs which increase the activity of the heart, so that it beats stronger and faster.

Cardiac Depressants are drugs which lessen the heart action so that the heart beats slower and weaker.

Carminatives are drugs which produce a feeling of comfort in the stomach and relieve the formation of gas in the stomach and the intestines. They also increase the appetite.

Cathartics are drugs which cause movements of the bowels.

Caustics are substances which burn or destroy tissues.

Cholagogues are drugs which cause movements of the bowels, the stools being colored with bile. They are said to increase the flow of bile.

Cerebral Stimulants are drugs which increase brain activity making the patient more active, brighter and more talkative (in large doses such drugs may produce delirium, hallucinations, convulsions, etc.).

Cerebral Depressants are drugs which lessen brain activity. The patient is dull and less active. In large doses they may produce sleep.

Convulsants are drugs which produce convulsions.

Correctives are substances used to make unpleasant drugs more pleasant to the taste.

Counterirritants are drugs which act on the skin. They cause redness of the skin, thus relieving inflammation in remote organs or tissues. By acting on the nerve endings in the skin they also relieve pain in remote organs.

Delirifacients are drugs which increase the activity of the brain, and which often cause delirium.

Demulcents are bland slippery liquids, used to coat, protect and lubricate a mucous membrane or surface of the body.

Deodorants are remedies which destroy unpleasant odors.

Depilatories are substances used to remove hair.

Depresso-motors are drugs which lessen the impulses for motion sent from the brain or spinal cord.

Depurants are drugs which increase the excretions of the body and thereby purify it.

Detergents are substances which clean wounds.

Diaphoretics are drugs which cause perspiration.

Digestives or **Digestants** are substances which aid the digestion of food.

Disinfectants are drugs which check the growth of bacteria.

Diuretics are drugs which increase the flow of urine, both in amount and frequency.

Ecbolics are drugs which contract the uterus and expel its contents; thereby producing abortion, or assisting labor.

Emetics are drugs which produce vomiting.

Emmenagogues are drugs which bring about menstruation.

Emollients are drugs which soften and protect the surface of the body.

Errhines are drugs which increase the nasal secretions, and produce sneezing.

Epispastics or **Escharotics** are drugs which produce blisters and destroy the skin of the area over which they are applied.

Excito-motors are drugs which increase the impulses for motion, that are sent out from the brain or spinal cord.

Expectorants are drugs which increase coughing and bronchial secretions.

Evacuants are drugs which move the bowels.

Febrifuges are drugs which reduce fever.

Galactogogues are drugs which increase the secretion of milk.

Haemostatics are substances which check bleeding.

Hydragogues are drugs which produce frequent watery movements of the bowels.

Hypnotics are drugs which produce sleep.

Laxatives are drugs which produce mild movements of the bowels.

Myotics are drugs which narrow (contract) the pupil of the eye.

Mydriatics are drugs which widen (dilate) the pupil of the eye.

Oxytocics are drugs which increase contractions of the uterus.

Prophylactics are medicines which prevent the development of a disease.

Purgatives are drugs which produce moderately active and frequent movements of the bowels.

Refrigerants are substances which relieve thirst and cool the patient, in fever.

Respiratory Stimulants are drugs which increase the depth and frequency of breathing.

Respiratory Depressants are drugs which lessen the frequency and depth of breathing.

Revulsants are drugs which draw blood from the deeper parts to the surface.

Rubefacients are drugs which redden the skin by widening (dilating) the capillaries.

Saline Purgatives are mineral salts which produce movements of the bowels.

Sedatives are drugs which lessen the activity of an organ or part of the body.

Sialagogues are substances which increase the flow of saliva.

Somnifacients or **Soporifics** are drugs which produce sleep.

Specifics are drugs which cure particular diseases; usually by destroying or combining with, the causative agent.

Stomachics are drugs which increase the activity of the stomach and intestines. They increase the appetite and aid digestion.

Styptics are substances which stop bleeding.

Sudorifics are drugs which produce sweating.

Taenicides are drugs which destroy tape worms.

Tonics are drugs which brace up the patient. They improve the health and vigor of every part of the body. They make the patient feel stronger, healthier, more energetic, and increase the appetite.

Vermicides are drugs which destroy worms.

Vermifuges are drugs which expel worms.

Vesicatories or **Vesicants** are drugs which produce blisters.

Vulneraries are drugs which promote the healing of wounds.

CHAPTER II

SYSTEMS OF WEIGHTS AND MEASURES

There are two systems of measuring drugs: one is the French or Metric System, the other is the English or Apothecaries' System.

The Metric system is the one which is used in all European countries; it has the following advantages: the units are divided into tenths, the units of length, volume and weight are similar, and the units of volume are equal to the units of weight.

In this country, the Apothecaries' System is still used, but it is gradually being superseded by the Metric System; and it is simply a question of time when the Apothecaries' System will be abandoned entirely.

THE METRIC SYSTEM

The elementary unit of measurement in the metric system is the one for length. This is the **meter**, which is about one ten-millionth part of the distance from the equator to the north pole. It is equal to about 39.37 inches and is written as 1.0 m.

TABLE OF LENGTH

The unit is	1.0	one meter
one tenth of the meter	"	0.1	one decimeter
" " " the decimeter	"	0.01	one centimeter
" " " the centimeter	"	0.001	one millimeter

TABLE OF SURFACE

A surface one meter long and one meter wide is called a **square meter,** 1.0 sq. m., which is the unit of surface.

This is divided into one hundred **square decimeters,** each of which is again divided into one hundred **square centi-**

meters. Each square centimeter is further subdivided into one hundred **square millimeters.**

TABLE OF VOLUME

The volume of a substance is the amount of space which it occupies.

A quantity of space one meter long, one meter wide and one meter high, is **one cubic meter,** which is the unit of volume.

This is divided into a thousand **cubic decimeters,** each of which is again divided into a thousand **cubic centimeters** and this in turn into a thousand **cubic millimeters.**

TABLE OF CAPACITY

In measuring fluids, we measure the quantity of fluid contained in a given space. The space which the fluid occupies varies with its character and temperature; thus an oily substance will occupy less space than boiling water. We therefore take the space occupied by water at 4° Centigrade as the standard.

The unit of capacity is the **liter,** which is the amount of water contained in a volume of one cubic decimeter.

The liter is divided into **deciliters, centiliters** and **milliliters.** The deciliter is a tenth, the centiliter a hundredth, and the milliliter a thousandth part of the liter. *Since the liter occupies one cubic decimeter of space, the milliliter will occupy one thousandth part of that, and is therefore equivalent to the* ***cubic centimeter.***

The new Pharmacopœia has adopted the term **mil,** the abbreviation for milliliter, instead of c.c. (cubic centimeter). For example, 50.0 c.c. are now written 50.0 mils, 0.3 **c.c.** as 0.3 mil, etc.

The quantities of medicinal fluids which the nurse is called upon to measure are usually less than a liter, so that the measuring apparatus in ordinary use are graduated in cubic **centimeters** (c.c.). In practice this is the unit ordinarily used in measuring fluids.

TABLE OF WEIGHT

Solid substances are usually measured by weight.

The unit for measuring weight is the **gramme**; which is the weight of one cubic centimeter of water at a temperature of 4° Centigrade, written:

	1.0 gm.	one gramme
one tenth of the gramme is	0.1 gm.	one decigramme
one hundredth of the gramme "	0.01 gm.	one centigramme
one thousandth of the gramme "	0.001 gm.	one milligramme

Units greater than one gramme are given definite names, thus:

10.0 gms. = 1 dekagramme
100.0 gms. = 1 hectogramme
1000.0 gms. = 1 kilogramme

Since 1.0 (one gramme) is the weight of 1 mil or 1 cubic centimeter of water, in expressing the quantities of fluids, which are measured by capacity, the denomination 1.0 means one mil or one cubic centimeter, 2.0, two mils or two cubic centimeters (2 c.c.), etc.

The nurse may overcome the difficulty of remembering the denominations of the metric system, if she remembers that the figures to the **left** of the decimal point, correspond to **dollars**, in our coinage system, and represent **grammes** in the metric system. The first figure to the right of the decimal point is the decigramme, the second centigramme, and the third milligramme, etc. This corresponds to dimes, cents and mills respectively in our coinage system.

For example: $1.53 is one dollar and fifty-three cents in our coinage system, and if we write it without the dollar sign, in the metric system for measuring weight, we call it one gramme and fifty-three centigrammes.

Practically, however, the only denominations used are the gramme, gm., and the milligramme, mg. Thus 5 decigrammes are written as 0.5gm. (five-tenths of a gramme), 0.06gm. may be called 60 milligrammes, etc.

APOTHECARIES' SYSTEM

TABLE OF WEIGHT

Measurement of Solids

The unit of measurement is the **grain**, which is equal to 0.065 gm. (sixty-five milligrammes) in the metric system. The grain is written thus: gr. i.

20 grains = 1 scruple ℈
3 scruples or 60 grains = 1 dram ʒ
480 grains or 8 drachms = 1 ounce ℥
5760 grains or 12 ounces = 1 pound lb.

TABLE OF CAPACITY

Fluid Measurement

The unit of measurement is the **minim**, which is equal to 0.065 c. c. It is written m. i.

60 minims = 1 fluid dram (ʒ)
8 fluid drams = 1 ounce (℥)
16 ounces = 1 pint (○)
2 pints = 1 quart (qt.)
4 quarts or 8 pints = 1 gallon (gal.)

TABLE OF EQUIVALENTS

Value of Metric Units in Apothecaries' Units

	Grain	Dram	Ounce	Pound
One milligramme . . .	0.01543	0.00026	.....	.....
One centigramme . . .	0.15432	0.0026	0.00032	.....
One decigramme. . . .	1.54324	0.0257	0.0032	0.00027
One gramme.	15.43236	0.257	0.03215	0.00270
One kilogramme. . . .	15432.3564	257.206	32.1508	2.6792

APPROXIMATE EQUIVALENTS OF METRIC UNITS

Weight

One milligramme	0.001 gm. =	$\frac{1}{64}$ of a grain
One centigramme	0.01 gm. =	$\frac{1}{6}$ of a grain
One decigramme	0.1 gm. =	$1\frac{1}{2}$ grains
One gramme	1.0 gm. =	$15\frac{1}{2}$ grains (in prescriptions 15 grains)
One kilogramme	1000.0	gms. = 32 ounces or $2\frac{2}{3}$ pounds

Capacity

One cubic centimeter, 1.0 c.c. = 15 minims
One liter, 1000.0 c.c. = 32 ounces or 2 pints (approximately one quart)

APPROXIMATE EQUIVALENTS OF APOTHECARIES' UNITS

Weight

One grain	= 0.065	gm. (65 milligrammes)
One dram	= 4.0	gm. (4 grammes)
One ounce	= 30.0	gm. (30 grammes)

Capacity

One minim	= 0.065	c.c.
One dram	= 4.0	c.c. (4 cubic centimeters)
One ounce	= 30.0	c.c. (30 cubic centimeters)
One pint	= 500.0	c.c. (500 cubic centimeters)
One quart	= 1000.0	c.c. (one liter)

HOUSEHOLD MEASUREMENTS

To measure the minim (m. i) or 0.065 gm.:

The minim is not exactly equal to the drop. There are many medicine droppers in practical use, from which each drop that is expelled, is approximately equal to **one minim.**

By a drop is usually meant the drop which falls from the mouth of a bottle when it is held horizontally. **Two or two and a half** of such drops, are approximately equal to **one minim.**

TABLE OF HOUSEHOLD EQUIVALENTS

℥i (one dram)	or 4.0 gms.	(4 grammes)	= one level teaspoonful
℥ii (two drams)	or 8.0 gms.	(8 grammes)	= one level dessertspoonful
℥iv (four drams)	or 16.0 gms.	(16 grammes)	= one level tablespoonful
		half an ounce	
℥viii (eight ounces)	or 240.0 c.c.	(240 cubic centimeters)	= one tumblerful.

METHOD OF REDUCING METRIC QUANTITIES TO THEIR APOTHECARIES' EQUIVALENTS

Rule 1. Multiply the metric quantity by 15; which gives the number of grains or minims, and reduce the result to its lowest terms.

(Since 1.0 is equal to 15 grains or 15 minims)

Example: Reduce 1.03 gms. (1 gramme and 3 centigrammes) to the apothecaries' equivalent.

Since 1.0 = 15 grains

$1.03 = 15 \times 1.03 = 15.45$ grains $\quad 15\frac{4.5}{10} = 15\frac{1}{2}$ grs.

Example: Reduce 64.0 gms. to its apothecaries' equivalent.

Since 1.0 = 15 grains

$64.0 = 64 \times 15 = 960$ grains

Since there are 480 grains in one ounce, in 960 grains there are $960 \div 480 = 2$ ounces, written ℥ii

Rule 2. Divide the metric quantity by 0.065 which gives the number of grains, and reduce the result to its lowest terms.

(Since 0.065 gm. = gr. i)

Example: Reduce 9.75 gms. to its apothecaries' equivalent.

$0.065 \overline{)9.75}$

150 grains = ℥ii$\frac{1}{2}$

To reduce very small metric quantities (less than 0.065) to their apothecaries' equivalents:

Rule 3. Write the metric quantity as the numerator of a fraction, of which the denominator is always 0.065 (65 milligrammes), and reduce the fraction to its lowest terms. The result is the fraction of a grain.

Example: Reduce 0.0004 (4 decimilligrammes) to its apothecaries' equivalent.

Since 0.065 (65 milligrammes) is equal to 1 grain,
0.0004 (4 decimilligrammes) is equal to

$$\frac{0.0004}{0.065} \text{ of a grain} =$$

$$\frac{00004}{00650} = \frac{4}{650} = \frac{1}{160} \text{ grain.}$$

0.0004 (4 decimilligrammes) is equal to $\frac{1}{160}$ grain.

METHODS OF REDUCING APOTHECARIES' UNITS TO THEIR METRIC EQUIVALENTS

Rule 1. Reduce the quantity to grains and divide the result by 15. The result is the number of grammes.

Since 15 grains = 1.0 gm. (1 gramme)

Example: Reduce ʒii (2 drams) to its equivalent metric quantity.

2 drams = 2 × 60 or 120 grains
120 ÷ 15 = 8
ʒii, 2 drams = therefore, 8 grammes

When larger quantities are dealt with, the following method is easier:

Rule 2. Reduce the quantity to drams and multiply the result by 4.

Since 1 dram = 4.0 (4 grammes)

Example: Reduce ʒv (5 ounces) to its metric equivalent.

Since 1 dram = 4.0 gms. (4 grammes)
5 ounces therefore = 160.0 gms. (160 grammes)

Rule 3. Reduce the quantity to grains and multiply the result by 0.065 (65 milligrammes).

(Since 1 grain = 0.065 gm.)

Example: Reduce ʒiss (1 dram and a half) to its metric equivalent.

One dram and a half = 90 grains
Since one grain = 0.065 gm., 90 grains will equal
$90 \times 0.065 = 5.85$ gms. (5 grammes and 85 centigrammes)

Rule 4. For very large quantities reduce the amount to ounces and multiply the result by 30.

Since one ounce = 30.0 gms. (30 grammes)

Example: Reduce 40 ounces to its metric equivalent.

Since one ounce = 30.0 gms. (30 grammes)
40 ounces = $40 \times 30.0 = 1200.0$ grammes.

To reduce fractional apothecaries' quantities to their metric equivalents.

Rule 5. Multiply the fraction by 0.065 (sixty-five milligrammes), and divide the denominator into the numerator.

The result is the equivalent metric quantity.

Example: Reduce $\frac{1}{100}$ grain to its metric equivalent.

Since 1 grain = 0.065 gm. (six centigrammes)

$$\frac{1}{100} \text{ grain} = \frac{1}{100} \times 0.065 = 100 \overline{)0.065}\ 0.0006$$

$\frac{1}{100}$ grain = 0.0006 gm. (six decimilligrammes).

Example: Reduce gr. $\frac{1}{250}$ to its metric equivalent.

Since 1 grain = 0.065 gm.

$$\frac{1}{250} \text{ grain is equal to } \frac{1}{250} \times 0.065 = 250 \overline{)0.065}\ 0.00026$$

$\frac{1}{250}$ grain = 0.00026 gm. (26 centimilligrammes).

APPROXIMATE EQUIVALENTS OF METRIC DOSES COMMONLY ORDERED

2.0	gms. (2 grammes)	=	30	grains
1.0	gm. (1 gramme)	=	15	grains
0.6	gm. (6 decigrammes)	=	10	grains
0.3	gm. (3 decigrammes)	=	5	grains
0.2	gm. (2 decigrammes)	=	3	grains
0.1	gm. (1 decigramme)	=	$1\frac{1}{2}$	grains
0.06	gm. (6 centigrammes)	=	1	grain
0.03	gm. (3 centigrammes)	=	$\frac{1}{2}$	grain

0.015	gm.	(15 milligrammes)	=	$\frac{1}{4}$ grain
0.008	gm.	(8 milligrammes)	=	$\frac{1}{8}$ grain
0.004	gm.	(4 milligrammes)	=	$\frac{1}{16}$ grain
0.0032	gm.	(32 decimilligrammes)	=	$\frac{1}{20}$ grain
0.0027	gm.	(27 decimilligrammes)	=	$\frac{1}{25}$ grain
0.0022	mg.	(22 decimilligrammes)	=	$\frac{1}{30}$ grain
0.0016	gm.	(16 decimilligrammes)	=	$\frac{1}{40}$ grain
0.0013	gm.	(13 decimilligrammes)	=	$\frac{1}{50}$ grain
0.0011	gm.	(11 decimilligrammes)	=	$\frac{1}{60}$ grain
0.001	gm.	(1 milligramme)	=	$\frac{1}{64}$ grain
0.0006	gm.	(6 decimilligrammes)	=	$\frac{1}{100}$ grain
0.0005	gm.	(5 decimilligrammes)	=	$\frac{1}{120}$ grain
0.0004	gm.	(4 decimilligrammes)	=	$\frac{1}{150}$ grain
0.0003	gm.	(3 decimilligrammes)	=	$\frac{1}{200}$ grain
0.0001	gm.	(1 decimilligramme)	=	$\frac{1}{600}$ grain

PROBLEMS

Reduce the following quantities to their apothecaries' equivalents.

24.06 gms. 11.0575 gms. 0.0055 gm. 0.0425 gm. 0.000275 gm.

Reduce the following quantities to their metric equivalents:

ʒiii and grs. xlii, ʒvii$\frac{1}{4}$, ℥i grs. xx, ℥iii and grs.vi, gr.$\frac{1}{15}$, gr. $\frac{1}{180}$, gr. $\frac{1}{215}$,

How would you measure the following quantities with household utensils ?

ʒii$\frac{1}{2}$, grs. xv, ♁iii $\frac{1}{2}$, 6.0 gm., 650.0 c.c., 15.0 c.c.

CHAPTER III

SOLUTIONS

A solution is a liquid containing particles of a solid, gas or another liquid, so finely divided, that this dissolved substance cannot be seen, and the resulting fluid seems to be of one color and consistency.

In this chapter we shall deal only with the methods of calculation and the technique of preparation of solutions. We shall leave the discussion of the chemical properties of solutions, or the way in which substances behave when dissolved, to the chapter on the administration of medicines, where many of these properties have a definite bearing. In order to understand the subject of solutions the nurse should have a clear conception of some of the following fundamental facts:

SOLUTE AND SOLVENT

1. The dissolved substance is called the **solute.**

2. The fluid in which a substance is dissolved is called the **solvent.**

Theoretically it is possible to dissolve any substance in any fluid. Practically, however, some substances dissolve so little in some fluids that we speak of them as being insoluble in these fluids.

The solvent may be any fluid: water, alcohol, ether, etc. The solution is frequently called by the name of the solvent, such as an alcoholic solution, ethereal solution, etc. In pharmacy certain definite names are given to substances dissolved in certain fluids, such as tincture, fluidextract, etc. (See preparations, page 4).

THE STRENGTH OF THE SOLUTION

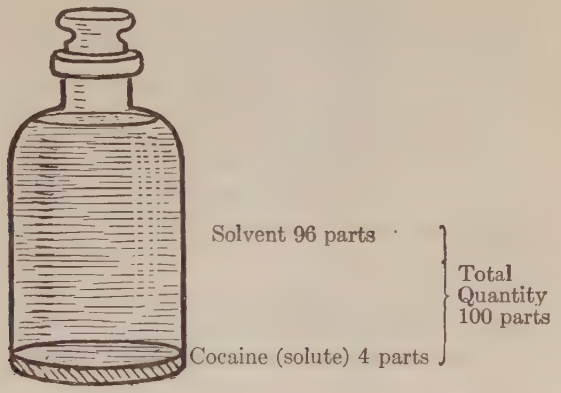
The strength of the solution is the amount of dissolved substance which a given quantity of fluid contains; or the

ratio of solute to solvent. It is customary to speak of the strengths of solutions in the following ways:

1. **The percentage method**
2. **The ratio method**
3. **The grains to the ounce method**

Percentage Method

In this method we speak of the quantity of dissolved substance (solute), which is contained in 100 parts of fluid (solvent); the solvent is, therefore, always constant. For example, by a 5% silver nitrate solution we mean that 5.0 gms. of silver nitrate are dissolved in 100 c.c. of water.



Percentage Strength

*Diagram showing the proportion of solute and solvent in a 4% solution of cocaine

To determine the percentage strength of a solution:

Rule: Divide the quantity of solute used by the total quantity of solution made up and multiply the result by 100.

Example: What is the percentage strength of a solution that contains 2.0 gms. of boric acid in 50.0 c.c?

The quantity of solute is 2.0 gms.
The total quantity of the solution is 50.0 c.c.
Dividing 2.0 by 50.0 = 0.04
Multiplying 0.04 by 100 = 4%

*The reader should remember that solutions are homogenous (of one color and consistency). There is no level separating the solute from the solvent. The level of the solute in this, as in all the following figures is purely diagrammatic; for purposes of illustration.

Ratio Method

In this method we speak of the quantity of fluid (solvent), in which one part of the drug (solute) is dissolved. The quantity of solute is therefore always constant (one part). For example, a 1 to 500 solution means that 1 part of solute is contained in 500 parts of water, 1 gm. in 500 c.c. or ʒi in 500

Ratio Strength

Diagram showing the proportion of solute and solvent in a 1:5 silver nitrate solution

drams. A 1 to 2,000 solution means that 1 part of solute is dissolved in 2,000 parts of water. A 1 to 30 solution means 1 part of substance is dissolved in 30 parts of water, etc.

To determine the ratio strength of a solution.

Since the first term of the ratio is always 1, it is only necessary to determine the second term of the ratio.

Rule: To determine the second term of the ratio strength, divide the total quantity of solution made up, by the quantity of solute used.

Example: What is the ratio strength of a solution of bichloride of mercury made by dissolving a 0.6 gm. tablet in 300 c.c. of water?

The total quantity of solution made up is 300 c.c.

The quantity of solute is 0.6 gm.

Dividing 300 by 0.6 we get 500, which is the second term of the ratio.

Since the first term is 1, the strength of the solution is 1 : 500.

Grains to the Ounce Method: This method is gradually being abandoned and consists of expressing the number of grains of drug dissolved in an ounce of fluid. Like the percentage method the amount of solvent is thus always constant.

Method of Changing Percentage Strengths to Equivalent Ratios:

For purposes of calculating solutions it is not essential to change the percentage to the ratio strength, because any percentage strength may be expressed as a ratio; thus 5% is 5:100, 2% is 2:100, etc.

A percentage strength may be changed to its equivalent ratio, however, in the following way:

Since in the ratio strength the dissolved substance (solute) is always 1, we have only to determine the quantity of fluid or solvent, in which one part of the drug is dissolved or the second term of the ratio.

Rule: Divide 100 by the percentage strength. This gives the second term of the ratio; the first term is always 1.

We thus determine the solvent of the ratio strength, which is the second term of the ratio.

Example: Change 2% to its equivalent ratio strength.

The solute in the percentage strength is 2. $2\overline{)100}\ 50$

Expressing this as the second term of the ratio we have 1:50.

Method of Changing Ratio Strengths to Equivalent Percentages.

Rule: Divide the first term of the ratio by the second, and multiply the result by 100. This gives the percentage strength.

We thus divide the dissolved drug (solute), by the fluid in which it is contained (solvent).

Example: Express a 1: 5000 solution of bichloride of mercury in its equivalent percentage strength.

The quantity of solvent in this example is 5000.
This contains 1 part of drug.
Dividing 1 by 5000 we get 0.0002.
Multiplying the result by 100 we get 0.02%.

SATURATION

It is not possible to dissolve any quantity of a drug in any fluid. **A solution which contains as much of a solid, gas, or another fluid as it can possibly dissolve, is called a saturated solution.** When more of the same substance is added to such a solution it does not dissolve, but falls to the bottom as a sediment, if it is heavier than the solvent, or rises to the top if it is lighter. The largest quantity of any substance which a fluid will dissolve is called the **saturation point** of that substance. Thus the largest quantity of sodium bicarbonate which can be dissolved in 100 c.c. of water is 8.0 gms.; its saturation point is therefore 8%.

The saturation point of all substances is not the same. Thus the saturation point of potassium chlorate is 6%; of silver nitrate 65%, etc. The saturation point also varies with the fluid in which the substance is dissolved. Thus the saturation point of quinine bisulphate in water is 10%, in alcohol it is 5%, etc.

Preparation of a Saturated Solution

A saturated solution may be prepared by finding the saturation point of the substance required, from the tables on pages 43 and 44, and preparing such a solution in the usual manner. The nurse may prepare such a solution, however, by merely adding the desired substance to the fluid until it no longer dissolves but forms a sediment. The fluid is then a saturated solution of the dissolved substance.

SUPERSATURATION

When a saturated solution of any substance is heated, it is able to dissolve more of the same substance. A solution which contains the largest quantity of a substance that it can dissolve when the fluid is heated is called a **supersaturated solution.** The largest quantity of a substance which may be dissolved in a boiling fluid is therefore called its **supersaturation point.** For example, the saturation point of magnesium sulphate in cold water is 54%, in boiling water it is 88%.

TABLE OF SATURATION POINTS OF COMMONLY USED SOLUTIONS FOR LOCAL USE

Name of Solution	Sat. Point in Water	Sat. Point in boiling Water	Sat. Point in Alcohol	Sat. Point in Glycerin
Alum	10%	80%	insoluble	freely when warm
Benzoic Acid	0.4%	6%	30%	....
Bichloride of Mercury	7%	33%	25%	7%
Boric Acid	5%	25%	7%	20%
Carbolic Acid	8%	All proportions	All proportions	All proportions
Cocaine	0.2%	Decomposed	17%	....
Cocaine Hydrochloride	70%	Decomposed	40%	....
Gallic Acid	1%	25%	20%	8%
Lead Acetate	30%	50%	3%	....
Potassium Bicarbonate	25%	Decomposed	insoluble	....
Potassium Carbonate	50%	70%	insoluble	....
Potassium Chlorate	6%	40%	slightly soluble	....
Potassium Permanganate	6%	25%	Decomposed	....
Silver Nitrate	65%	90%	4%	....
Sodium Borate	5%	66%	insoluble	50%
Sodium Bicarbonate[1]	8%	Decomposed	insoluble	....
Sodium Carbonate	25%	35%	insoluble	....
Sodium Chloride	26%	30%	insoluble	....
Tannic Acid	75%	very soluble	30%	....
Zinc Sulphate	65%	83%	insoluble	....

[1] It may be noted that sodium bicarbonate is decomposed by boiling, which occurs in solutions of any strength. This should be remembered in preparing sterile sodium bicarbonate solutions for intravenous use. The solution cannot therefore be sterilized after it is prepared. The powder itself may be sterilized by dry heat of a low temperature and dissolved in sterile water when needed.

TABLE OF SATURATION POINTS OF COMMONLY USED SOLUTIONS FOR INTERNAL ADMINISTRATION

Name of Solution	Sat. Sol. in Water	Sat. Sol. in boiling Water	Sat. Sol. in Alcohol	Sat. Sol. in Glycerin
Ammonium Carbonate	20%	Decomposed	....	....
Ammonium Chloride	33%	50%	2%	17%
Ammonium Bromide	45%	53%	7%	....
Ammonium Iodide	62%	70%	10%	....
Calcium Oxide	0.1%	0.06%	insoluble	....
Hydriodic Acid	10%	All proportions	All proportions	....
Lithium Bromide	62%	70%	very soluble	....
Magnesium Sulphate	54%	88%	insoluble	....
Methyl Salicylate	slightly	very	very	....
Potassium Acetate	71%	More soluble	33%	....
Potassium Bicarbonate	25%	Decomposed	insoluble	....
Potassium Bitartarate	0.5%	5%	slightly	....
Potassium Bromide	50%	50%	0.5%	....
Potassium Citrate	66%	very	slightly	....
Potassium Iodide	100%	100%	8%	30%
Potassium and Sodium Tartarate	45%	50%	insoluble	....
Quinine Bisulphate	10%	Decomposed	5%	5%
Quinine Hydrochloride	100%	Decomposed	62%	11%
Quinine Salicylate	1%	Decomposed	8%	6%
Quinine Sulphate	0.1%	Decomposed	1%	3%
Salicylic Acid	0.3%	6%	33%	....
Sodium Acetate	50%	All proportions	4%	....
Sodium Bicarbonate	8%	Decomposed	insoluble	....
Sodium Citrate	50%	71%	slightly	....

TABLE OF SATURATION POINTS OF COMMONLY USED SOLUTIONS FOR INTERNAL ADMINISTRATION—*Continued*

Name of Solution	Sat. Sol. in Water	Sat. Sol. in boiling Water	Sat. Sol. in Alcohol	Sat. Sol. in Glycerin
Sodium Bromide.....	50%	55%	7%	....
Sodium Iodide.....	100%	100%	25%	....
Sodium Salicylate.....	55%	very soluble	15%	....
Strontium Bromide.....	50%	70%	very soluble	....
Sodium Sulphate.....	26%	Decomposed	insoluble	soluble
Sodium Phosphate.....	15%	Decomposed	insoluble	....

PREPARATION OF SOLUTIONS

The solutions which the nurse usually has to prepare are all used externally or on mucous membranes. They may be used as antiseptics in the form of wet dressings, as gargles, douches, enemas, etc. Normal salt solution is the only one which may also be given intravenously.

All the external solutions which the nurse may be called upon to prepare may be divided into the following three groups:

(a) Solutions made from tablets.
(b) Solutions made from powders or crude substances.
(c) Solutions made from stock solutions.

SOLUTIONS MADE FROM TABLETS

Problem: To find the quantity of water in which to dissolve a tablet of known strength to make up a solution of a desired strength.

Example: In how much water would you have to dissolve a 0.3 gm. (grs. v) tablet of bichloride of mercury, to make up a 1–2000 solution?

Let X represent the unknown number of cubic centimeters

of water to be used; then the tablet has the same ratio to the unknown number of cubic centimeters of water, as 1 is to 2000; since whatever the quantity of fluid will be, the 0.3 gm. or grs. v tablet must be $\frac{1}{2000}$ part of it. Writing the problem in the form of a proportion, we have:

$$0.3 : X :: 1 : 2000$$

The extremes in this example are 2000 and 0.3
" means " " " " X and 1

Since in any proportion, **the product of the means is always equal to the product of the extremes,**

we find that the number of c.c. or
$X = 0.3 \times 2000 = 600.$ c.c.

We must dissolve the tablet in about 600 c. c. of water, which is approximately one pint.

Rule 1. Write the problem in the form of a proportion in which the stock tablet has the same ratio to the unknown quantity of water (represented by X) as the ratio of drug to water in the desired strength; thus:

Strength of tablet: X :: drug: water (in desired strength), X being the amount of water to be used.

(In any proportion the outer numbers are called extremes and the inner ones means). The product of the means of any proportion is always equal to the product of the extremes.

Multiply both means together and both extremes together. Since their products are equal an equation is thus formed. By dividing the right side of the equation by the left with the exception of the X, we determine the value of X, or the quantity of water in which the tablet is to be dissolved.

Any problem can be solved in this manner no matter whether the strength of the desired solution is expressed in the percentage or ratio method; since in either case the required strength may readily be expressed as a ratio. The strength of the tablet, however, should always be expressed in its metric equivalent.

Example: In how much water must a gr. vii$\frac{1}{2}$ tablet of bichloride of mercury be dissolved to prepare a 1:5000 solution?

1. Reduce grs. $7\frac{1}{2}$ to its metric equivalent

Since gr. i = 0.065 gm.

then, $7\frac{1}{2}$ grs. = $7\frac{1}{2} \times 0.065 = 0.5$ gm.

$0.5 : X :: 1 : 5000$

therefore, $X = 0.5 \times 5000 = 2500$

* —or X = 2500 c.c. = $2\frac{1}{2}$qts.

(1000 c.c. = 1 quart)

SOLUTIONS MADE FROM POWDERS OR CRUDE SUBSTANCES

Problem: To find the quantity of drug to be used to make up a desired quantity of a given strength of solution.

Rule 2. Write the problem in the form of a proportion in which the unknown quantity of powder or other crude substance to be used (represented by X) has the same ratio, as the ratio of drug to water in the required strength, thus:

X (the quantity of drug to be used): the quantity to be made up :: the amount of drug : water (in the desired strength)

By multiplying both extremes together and both means together and dividing, the value of X or the quantity to be made up is determined.

This method may be used to prepare solutions from powders, from a number of tablets, or from other crude substances in pure state.

Example: How much potassium chlorate would be necessary to make up one pint of a 4% solution?

One pint = 500 c.c., 4% = 4:100

Let X = the amount of drug to be used, then

$X : 500 :: 4 : 100$

* The bottle shows the unknown quantity of fluid represented by the X.

Again, the product of the extremes is equal to the product of the means.

Extremes are, 100 and X
Means are 4 and 500
therefore, 100 X = 4 × 500, or 2000

or X = 20 grammes

20 grammes of potassium chlorate must be added to 500 c.c. (1 pint) of water to make up a 4% solution.

In the above examples, it is important to reduce all the quantities to their metric equivalents, as apothecaries' quantities cannot be multiplied by metric quantities. For example, grains cannot be multiplied by grammes or cubic centimeters.

The problems may be solved in the apothecaries' quantities if they are reduced to ounces, drams or minims.

Example: How much boric acid would be necessary to make up one quart of a 2% solution?

1. Reduce all the quantities to the apothecaries' units, preferably to grains or minims.

One quart = 15360 minims

A 2% solution is approximately 10 grains to the ounce (480 grains equals one ounce). A 2% solution is approximately 10:500 or 1:50 then

Let X = the number of grains to be used, then
X : 15360 :: 1 : 50 or
50 X = 15360 grains
X = 50 | 15360
307 grains

307 grains = 5 drams (since 1 dram = 60 grains)

When the quantity to be made up is not stated:

Frequently the nurse is required to prepare a solution from a powder or crude substance in which the quantity of solution to be made up is not stated. In such instances she may use her judgment and prepare a quantity sufficient for the particular purpose required.

* The dish represents the unknown quantity of powder to be determined.

Example: The physician orders an ear to be irrigated with a 3% boric acid solution which the nurse must prepare. She will know from experience that about 500 c.c. of such a solution will probably be needed. She should then use 500 c.c. as the quantity to be made up and solve the problem in the manner outlined above.

Or, suppose a 5% solution of sodium of bicarbonate is ordered for a gastric lavage, when the quantity of fluid is not stated. From experience she will know that for this purpose about five or six pints of such a solution will be necessary. Consequently she should prepare about 2500 or 3000 c.c. of such a solution and solve the problem in the manner outlined above.

SOLUTIONS MADE FROM STOCK SOLUTIONS

In hospital practice the nurse frequently has to prepare solutions from other stock solutions. *The solutions commonly prepared are usually weaker than the stock solution.*

Stronger solutions from weak ones can only be made by adding more crude substance.

When the quantity of stock solution to be used has been determined, it should be measured and poured into the desired receptacle. This quantity is then subtracted from the amount to be made up, which gives the quantity of water which must be added, to make up the desired solution.

Example: How much of a 5% silver nitrate solution must be used to make up 30 c.c. or 1 ounce of a 1 to 100 solution?

The stock silver nitrate solution in this problem is the 5% solution.

If we represent the amount of stock solution to use by X, then the quantity to be used has the same ratio to the quantity of solution to be made up (in this case 30 c.c.) as the ratio of drug to water in the required strength (in this case 1 to 100); since the 30 c.c. must contain 1 part of silver nitrate for every 100 parts of water.

This example, written in the form of a proportion is:

$$X : 30 :: 1 : 100$$

This proportion would be true, if the stock solution were

of full strength or 100%. Since it is only a 5% solution and contains only $\frac{5}{100}$ of the drug, the amount of stock solution is only $\frac{5}{100}$ of X; then the correct proportion is:

$$\frac{5}{100}\,X : 30 :: 1 : 100$$

In this proportion the means are 1 and 30, and the extremes, $\frac{5}{100}$ X, and 100.

Since in every proportion, the product of the means is always equal to the product of the extremes, then,

$$\frac{5}{100}\,X \times 100 = 30 \times 1$$

Dividing both sides of the equation by the figures of the left side (except the X),

$$X = \frac{1}{100} \times \frac{100}{5} \times 30 \times 1$$

(Since, when we divide an equation or proportion by the numbers on one side of the equation, these numbers become inverted on the other side; thus 2000 becomes $\frac{1}{2000}$, $\frac{1}{100}$ becomes $\frac{100}{1}$, etc.)

A therefore, $X = \frac{1}{5} \times 30 = 6.0$ c.c.

In other words, the stock solution will be $\frac{1}{5}$ of the required solution or 6.0 c.c.

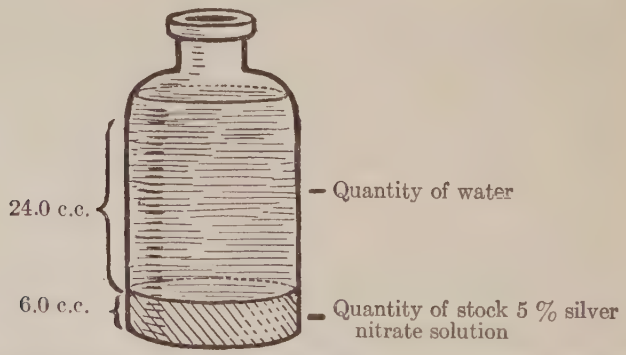


Diagram showing the quantity of 5% silver nitrate solution to use and the quantity of water to be added to make up 30 c.c. of a 1:100 silver nitrate solution.

Problem: To find the quantity of a stock solution of known strength to use in making up a weaker solution of a desired strength.

Author's Method

Rule 3. Multiply the strength of the desired solution expressed as a fraction, by the strength of the stock solution also expressed as a fraction (but inverted) by the quantity to be made up (preferably expressed in c.c.).

The result is the quantity of stock solution to use.

Subtract this result from the total quantity to be prepared, which gives the quantity of water to be added to make up the necessary solution.

The method may be used whether the desired solution and the stock solution are expressed in the percentage or the ratio strength. In either case the strength can be readily changed to a fraction. For example 1 : 3000 is the same as $\frac{1}{3000}$; 2% is the same as $\frac{2}{100}$.

The same method may be used when the quantity of solution to be made up is expressed in the apothecaries' quantities. It should then be remembered, however, that the result will be an apothecaries' quantity.

Technique of Preparation: Measure the quantity of stock solution determined by solving the problem and pour it into the bottle or dish in which the solution is to be prepared. Add to this the quantity of water determined by subtracting the above result from the desired quantity of solution.

Rationale of the Method

By multiplying the strength of the desired solution by the strength of the stock solution inverted, we are really dividing the strength of the desired solution by the strength of the stock solution. We thus determine what part of the desired solution will be stock solution. Since the desired solution is always weaker than the stock solution, the quantity of stock solution that will have to be used will always be a fraction of the total amount of the finished solution. By the above process we determine in each problem what fraction the stock solution will be of the desired solution. By multiplying this fraction by the

quantity to be prepared, we obtain the actual quantity of stock solution to use.

In the above example, in working out the value of X we found that the stock solution was $\frac{1}{5}$ of the amount to be prepared. See **A**, page 50. Multiplying this fraction by the number of c.c. to be prepared, which in the above example was 30, we obtained 6.0 c.c. as the quantity to be used.

Practically, however, the division of the strength of the required solution by that of the stock solution, and multiplying the result by the quantity to be prepared is facilitated and carried out in one step by working the problem according to Rule 3 above.

In each of the following examples the diagrams show what part of the desired solution is stock solution.

Example: How much of a 5% solution of bichloride of mercury will have to be used to make up 1000 c.c. (one quart) of a 1–2500 solution?

The strength of the desired solution is 1 : 2500

Expressed as a fraction it is $\frac{1}{2500}$

The stock solution is 5%; expressed as a fraction it is $\frac{5}{100}$ and inverted it is $\frac{100}{5}$

The number of cubic centimeters to be made up is 1000, then

$$\frac{1}{\frac{\cancel{2500}}{25}} \times \frac{\cancel{100}}{5} \times \frac{200}{\cancel{1000}} = X \text{ or } X = \frac{200}{25} = 8$$

The amount of the 5% solution of bichloride of mercury to be used, is therefore, 8 c.c. Subtracting this from 1000 we get the quantity of water to be added to make up 1000 c.c. of a 1 to 2500 solution.

Example: How much of a solution of silver nitrate, containing 48 grains to the ounce, must be used to make up one pint of a 1 to 1000 solution?

A solution of silver nitrate, containing 48 grains to the ounce is the same as 48 grains to 480 grains; or $\frac{48}{480} = \frac{1}{10}$ or a ten per cent solution, or $\frac{10}{100}$ or $\frac{1}{10}$.

1 pint = 500 c.c.

The solution to be made up, is a 1 to 1000; written as a fraction it is $\frac{1}{1000}$

The stock solution is a 10% solution, or 1 to 10, written as a fraction it is $\frac{1}{10}$ and inverted, it is $\frac{10}{1}$

then $\frac{1}{\cancel{1000}\ 2} \times \frac{10}{1} \times \cancel{500} =$ the amount of stock solution to use

$$X = \frac{10}{2} = 5$$

The amount of the stock silver nitrate solution to use, is therefore 5.0 c.c. Subtracting this from 500, we get the quantity of water to be added.

Example: How much of a 1 to 1000 potassium permanganate solution will have to be used in making up five pints of a 1–3000 solution?

The desired solution is $\frac{1}{3000}$

The stock solution is $\frac{1}{1000}$, inverted $\frac{1}{1000} = \frac{1000}{1}$

5 pints = 2500 c.c. (since 1 pint = 500.0 c.c.)

$$\text{then } \frac{1}{\cancel{3000}\ 3} \times \frac{\cancel{1000}}{1} \times 2500 = X$$

$$X = \frac{2500}{3} = 833\tfrac{1}{3} \text{ c.c.}$$

Subtract this from 2500 c.c. (5 pints) to get the quantity of water to be added.

Pour the 833 c.c. of the stock solution into the receptacle and add the necessary quantity of water.

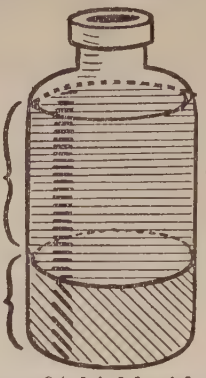


Diagram showing the quantity of a 1:1000 potassium permanganate to use and the quantity of water to be added to make up 5 pints of a 1:3000 solution.

Example: How much of a 5% bichloride of mercury solution must be used to prepare ℥xx of a 1:2000 solution?

The desired solution is 1 : 2000, expressed as a fraction it is $\frac{1}{2000}$.

The stock solution is a 5% solution, expressed as a fraction it is $\frac{5}{100}$, and inverted it is $\frac{100}{5}$.

The required quantity is ℥xx

According to the rule,

$$\frac{1}{\cancel{2000}\ \cancel{20}} \times \frac{\cancel{100}}{5} \times \cancel{20} = \frac{1}{5}$$

We therefore have to use ℥ $\frac{1}{5}$ or ʒi and m. xxxvi of the stock solution.

Subtracting this from ℥xx we get the quantity of water to be added.

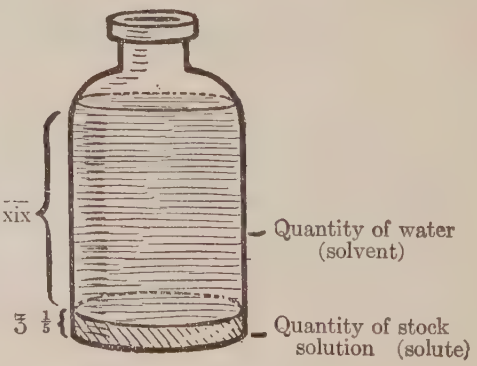


Diagram showing the quantity of 5% bichloride of mercury to use and quantity of water to be added, to make up ℥xx of a 1:2000 solution.

When the quantity to be made up is not stated:

When the quantity of a desired solution to be made up from a stock solution is not stated, the nurse may use her judgment and prepare a quantity needed for the purpose for which the solution is to be used. She may then solve the problem in the manner outlined above, using this quantity as the quantity to be made up.

Problem: To make up a definite quantity of stock solution from stock tablets of a definite strength.

The method of Rule 3 may also be used to determine the number of tablets needed to make up a definite quantity of solution from stock tablets of a definite strength. When solving the problem, however, we use the strength of the tablet expressed as a fraction, instead of the strength of the stock solution. The result will be the number of tablets to be used.

Example: How many tablets of novocaine gr. $\frac{1}{4}$ must be used to prepare 100 c.c. of a 1% solution?

The solution required is 1%.

The stock tablets are gr. $\frac{1}{4}$. The quantity to be prepared is 100 c.c. or 1500 minims.

According to the rule $\frac{1}{100} \times \frac{4}{1} \times 1500 = 60$.

Sixty gr. $\frac{1}{4}$ tablets when dissolved in 100 c.c. of water make a 1% solution.

SUMMARY OF SOLUTIONS

The difficulty of working problems in solutions may be readily overcome if the nurse will work out each problem in a systematic manner. Before solving any problem she should determine the following points:

1. Is the problem one in which she is to determine the quantity of water in which to dissolve a given tablet? Such problems should be worked out according to Rule 1, page 46.

2. Is the solution to be prepared from a powder, a salt or other crude substance? Such problems may be solved by Rule 2, page 47.

3. Is the problem one in which it is required to prepare a definite quantity of a weaker solution from a stronger stock solution? These problems should be solved according to Rule 3, page 51.

When the group to which the problem belongs has been determined, the problem should be solved according to the appropriate rule, preferably with pencil and paper.

Finally, it must be remembered that one can only become expert in the solving of solution problems by continual practice.

TABLE OF USUAL STRENGTHS OF COMMONLY USED SOLUTIONS FOR EXTERNAL USE

Name of Solution	Percentage of Solution	Quantity to Quart
Alcohol	50 to 95%	℥xvi–xxx
Aluminium Acetate (Burrow's Solution) Stock sol.	2 to 7%	ʒv–℥ii
Aluminium Acetate (Burrow's Solution) for local use	½ to 2%	ʒi–v
Argyrol	5 to 25%	℥i½–viii
Boric Acid	3%	℥i
Calcium Hydroxide Solution (lime water)	1/5%	ʒss
Carbolic Acid	2 to 5%	ʒv–℥i½
Collargol	4%	ʒi¼
Cocaine Hydrochloride	½ to 4%	ʒi¼
Chlorine Water	0.4%	
Corrosive Sublimate (Bichloride of Mercury) Stock Alcoholic Solution	2%	ʒv
Corrosive Sublimate (Bichloride of Mercury) (for use)	0.01 to 0.1% (1–1000 to 1–10000)	grs. ii–xv
Creolin	½ to 2%	ʒi¼–v
Cresol	5%	℥i½
Eserine Sulphate	½ to 1%	ʒi¼–ii½
Eserine Salicylate	½ to 1%	ʒi¼–ii½
Formalin (Stock) Solution	40% of formaldehyde gas	
Formalin (for use)	0.05 to ½%	gr. x–ʒi¼
Holocain	1 to 2%	℥ii½–v
Hydrogen Peroxide	3%	℥i

TABLE OF USUAL STRENGTHS OF COMMONLY USED SOLUTIONS FOR EXTERNAL USE

Name of Solution	Percentage of Solution	Quantity to Quart
Ichthyol	5 to 50%	℥i½–xvi
Iron Subsulphate (Monsell's Solution)	13%	℥iv
Iron Tersulphate	10%	℥iii
Iodoform	5 to 10%	℥i½–iii
Labbaracque's Solution (Solution of Chlorinated Soda)	2½%	℥vi
Lugol's Iodine Solution	5%	℥i½
Lysol	½ to 3%	℥i–℥i
Naphthol	1 to 50%	℥ii½–xvi
Pilocarpine Hydrochloride	½ to 2%	℥i¼–v
Potassium Chlorate	2 to 5%	℥v–℥ i½
Potassium Permanganate	1 to 5%	℥ii½–℥ i½
Protargol	½ to 10%	℥i¼–iii
Resorcin	25%	℥viii
Sodium Chloride (salt) (Normal Solution)	0.9%	℥ii
Sodium Chloride (salt) (Physiological Solution)	0.6%	℥i½
Silver Nitrate	1 to 20%	℥ii½–vi
Zinc Chloride	1 to 2%	℥ii½–v
Zinc Sulphate	¼%	grs. xxv

PROBLEMS

Strengths

Express the percentage strength of the following solutions:

1. 150.0 c.c. of solution containing a 0.3 gm. tablet of bichloride of mercury.
2. 500.0 c.c. of solution containing 0.6 gm. of potassium permanganate.
3. 30.0 c.c. of solution containing 0.5 gm. of boric acid.
4. One quart of solution containing ℥ii of alcohol.
5. One pint containing ℥i¼ of carbolic acid.

Express the ratio strength of the following solutions:

1. 500 c.c. of solution containing 10.0 gms. of boric acid.
2. 3000 c.c. containing 0.25 gm. of silver nitrate.
3. 5 pints of solution containing two gr. viiss tablets of bichloride of mercury.
4. One pint of solution containing ʒvi and grs. xv of silver nitrate.
5. ℥x of solution containing ʒv of carbolic acid.

Express the following percentages in ratios: 4%, 0.6%, 0.9%, 8%, 20%.

Express the following ratio strengths in percentage: 1 : 30, 1 : 2500, 1 : 60, 1 : 5000, 1 : 75.

Solutions from Tablets

In each of the following problems determine the quantity of water to be used:

1. To prepare a 1 : 8000 solution from a 0.2 gm. tablet of bichloride of mercury.
2. To prepare a 1 : 12000 solution from a gr. viiss tablet of corrosive sublimate. How would you measure and prepare such a solution in a home?
3. To prepare a ½% solution from a 0.3 gm. tablet of potassium permanganate.
4. To prepare a ½% solution of novocaine from tablets of gr. ¼.
5. To prepare a 1 to 2500 solution of mercury oxycyanide from a 0.1 gm. tablet.
6. To prepare a 1 to 20 solution of sodium bicarbonate from a tablet of gr. v.
7. To prepare a ½% solution of mercury oxycyanide from a tablet of 0.5 gm.
8. To prepare a 5% solution of corrosive sublimate from a tablet of 0.1 gm.
9. To prepare a solution of bichloride of mercury containing gr. v to the ℥i from tablets of gr. iii.
10. To prepare a bichloride of mercury solution gr. i to the quart from tablets of 0.1 gm.

Solutions from Powders and Crude Substances

In each of the following problems determine the quantity of powder or crude substance to be used:

1. To prepare two quarts of a 2% boric acid solution.

2. To prepare one quart of a saturated solution of sodium bicarbonate.

3. The quantity of salt needed to prepare one quart and a half of physiological salt solution.

4. The quantity of salt needed to prepare enough normal salt solution for two intravenous infusions.

5. To prepare 1 pint of a $\frac{1}{2}\%$ creolin solution.

6. To prepare one gallon of a 2% carbolic acid solution.

7. To prepare 8 ounces of a 25% glycerine solution.

8. To prepare a saturated solution of sodium bicarbonate for an ear irrigation.

9. To prepare a 5% sodium bicarbonate solution for washing out the stomach.

10. To prepare a saturated boric acid solution for an ear irrigation.

From Stock Solutions

In each of the following problems determine the quantity of stock solution to be used:

1. To prepare 2500 c.c. of a 1 : 8000 solution of bichloride of mercury from a 5% solution.

2. To prepare 1000 c.c. of a 1 to 5000 solution of bichloride of mercury from a 1 to 30 solution.

3. To prepare 1 gallon of a 2% solution of creolin from a 1 : 4 solution.

4. To prepare 1000 c.c. of a 1 : 500 Burow's solution from a 2% solution.

5. To prepare one quart of a 1 : 10000 silver nitrate solution from a $\frac{1}{2}\%$ solution.

6. To prepare 15 ounces of a 2% carbolic acid solution from a 50% solution.

7. To prepare 500 c.c. of a $\frac{1}{2}\%$ solution of formalin from a 40% solution.

8. To prepare enough of a 1 : 5000 solution of mercury oxycyanide from a 2% solution for a bladder irrigation.

9. How many tablets of cocaine hydrochloride gr. $\frac{1}{8}$ should be used to prepare 4 ounces of a $\frac{1}{2}\%$ solution?

10. How many tablets of morphine sulphate gr. $\frac{1}{4}$ should be used to prepare 60 c.c. of a Magendie's solution?

Miscellaneous

In each of the following problems determine the rule to be applied and work out the problem accordingly:

1. In how much water should a gr. v bichloride of mercury tablet be dissolved to prepare a 0.05% solution.

2. How many tablets of cocaine hydrochloride gr. $\frac{1}{8}$ should be used to make ℥ii of a 1 : 50 solution?

3. How much sodium bicarbonate should be used to prepare a sufficient quantity of a 5% solution for five wet dressings for a wound of the hand?

4. How much of a 3% solution should be used to prepare 1500 c.c. of a 1: 10000 silver nitrate solution?

5. How much phenol should be used to prepare 30 c.c. of a $\frac{1}{2}$% solution?

CHAPTER IV

THE PREPARATION OF DOSES

All drugs are poisons—they are harmful to the body. In fact some of them may even cause death if given in sufficiently large quantities. They injure the body by making one or more organs excessively active (overstimulation), by lessening activity to a very marked degree (excessive depression), or by destruction of the cells (irritation).

We take advantage of these changes which drugs cause in the activity of organs or tissues and utilize the drugs in the treatment of disease to produce desired effects.

Beneficial and poisonous effects differ only in degree and depend upon the size of the dose given. Thus a small quantity of a substance will produce beneficial effects while a larger one may cause poisonous effects.

DOSAGE

By experiments on animals we can determine the smallest quantity of a drug that must be given to produce any change in the activity of an organ or tissue of the body. This is the smallest or **minimum dose.** By similar experiments we can determine the largest quantity of the same drug which may be given without causing dangerous effects. This is the **maximum dose.** A quantity of a drug which exceeds this maximum dose is called an **overdose** or **poisonous dose.** Such doses may cause dangerous or poisonous symptoms. All drugs have different doses; if several substances happen to have the same dose it is merely a coincidence.

Rule for Dosage

There is no rule whereby the doses of all drugs may be remembered. The dose of each drug must be memorized. The following rule, however, will facilitate the remembering

of the principal preparations of the common potent drugs such as opium, nux vomica, belladonna, digitalis, etc.

The dose of the **crude** drug is gr. i or 0.065 gm.

Fluidextracts represent 100% of drug, therefore the dose is the same as the crude drug, but in fluid measure: **m. i or 0.065 gm.**

Tinctures are 10% solutions; they are $\frac{1}{10}$ as strong as the drug, therefore the dose is 10 times that of the crude drug but in fluid measure; of the potent drugs it is usually **m. x or 0.6 c.c.**

Extracts are concentrated solid preparations which are about 4 times as strong as the crude drug; therefore the dose is $\frac{1}{4}$ as much as the crude drug; of the potent drugs it is usually **gr. $\frac{1}{4}$ or 0.015 gm.**

Conditions Influencing the Dose

Age: An older person usually requires a larger dose than a younger one. Old people and children, however, require smaller doses.

Sex: Males usually require larger doses than females.

Weight: Heavier, stouter individuals usually require larger doses than lighter ones.

Temporary conditions: After a meal more absorption usually takes place, therefore the effects are usually more marked.

Time of Administration: Some substances produce better effects at different times. Thus drugs which produce sleep cause little effect in the morning and a better effect at night.

Pregnancy: In pregnancy potent remedies should be given in the smallest quantities; since they are apt to cause abortion.

Lactation: In the nursing woman care must be exercised in the doses of many remedies which are eliminated in the milk and which may therefore induce poisonous symptoms in the nursing child.

CALCULATION OF DOSES

Potent drugs usually come in the form of tablets of definite doses for hypodermic use. They are frequently put up combined with various other drugs with which they are com-

monly given. In hospital practice, for reasons of economy, potent substances are often kept in solutions of various strengths. Frequently, however, a dose may be ordered other than that of the usual tablets, or, the nurse may be called upon to give a dose that she cannot readily measure from the solution in stock. In such instances she will have to calculate the dose required either from the tablets of the usual dose or from a stock solution of a definite strength.

CALCULATION OF DOSES FROM TABLETS

Problem: To give a fractional dose from a tablet of a definite strength.

When a dose of a drug is ordered for hypodermic or internal use other than the usual strengths of tablets in stock, the following method will enable the nurse to calculate and prepare the correct dose:

Rule 1. Divide the required dose by the strength of the stock tablet. This gives the fraction of the tablet to be given.

Technique: Dissolve the stock tablet in a quantity of water in which the denominator of this fraction can be divided evenly. Give the patient this fraction of the quantity of water in which the tablet has been dissolved.

If the answer is **more than 1 and a whole number,** then the number of tablets indicated by this number should be given.

If the answer is a **whole number and a fraction, dissolve one tablet in a quantity of water in which the denominator of the fraction can be divided evenly. Take the fraction of that amount of water and add to it the number of tablets indicated by the whole number.**

Example 1: How would you prepare strychnine sulphate gr. $\frac{1}{60}$ from tablets of gr. $\frac{1}{30}$?

According to the rule:

$$\frac{1}{60} \div \frac{1}{30} = \frac{1}{60} \times \frac{30}{1} = \frac{30}{60} = \frac{1}{2}$$

We therefore have to give $\frac{1}{2}$ of the gr. $\frac{1}{30}$ tablet. By dissolv-

ing this tablet in m. xx of water (into which 2 can be divided evenly) and giving the patient $\frac{1}{2}$ of that or m. x, we will give the correct dose.

Example 2. How would you give gr. $\frac{1}{120}$ of atropine sulphate from tablets of gr. $\frac{1}{100}$?

The required dose is gr. $\frac{1}{120}$, the stock dose is gr. $\frac{1}{100}$. According to the rule, $\frac{1}{120} \div \frac{1}{100} = \frac{1}{120} \times \frac{100}{1} = \frac{5}{6}$.

We therefore have to give $\frac{5}{6}$ of the gr. $\frac{1}{100}$ tablet.

Since 6 can be divided evenly in m. xxx of sterile water, we dissolve the gr. $\frac{1}{100}$ tablet in that number of minims of water, and give the patient $\frac{5}{6}$ of it or m. xxv.

Example 3. How would you give gr. $\frac{1}{30}$ of strychnine sulphate from tablets of gr. $\frac{1}{50}$?

The required dose is gr. $\frac{1}{30}$, the dose in stock is gr. $\frac{1}{50}$.

According to the rule, $\frac{1}{30} \div \frac{1}{50} = \frac{1}{30} \times \frac{50}{1} = \frac{50}{30} = 1\frac{2}{3}$ tablets.

Since 3 (the denominator of $\frac{2}{3}$) can be divided evenly into 30, we dissolve 1 tablet in m. xxx of water and take $\frac{2}{3}$ of that or m. xx. To this we add another tablet of gr. $\frac{1}{50}$.

Problem: To prepare a necessary number of doses from one or more tablets of another dose.

The nurse is occasionally called upon to prepare a number of doses from one or more tablets of another dose. The following method will enable her to prepare the necessary quantity and to administer accurate doses from this quantity.

Rule: Divide the total quantity of the tablets in stock by the dose to be administered.

The result will be the number of c.c. in which the tablet should be dissolved.

Technique: To administer the correct dose give 1.0 c.c. (m. xv) of this quantity each time.

The tablet may also be dissolved in a number of *minims* indicated by the result, of which m. i. is given each time. This method is not as good since it necessitates working with smaller quantities.

Example: The doctor orders the patient to get strychnine sulphate gr. $\frac{1}{300}$ every two hours. The nurse has only one

tablet of gr. $\frac{1}{300}$. How many doses can she prepare from the tablet and how should she prepare an accurate dose each time?

There are as many doses as $\frac{1}{300}$ is contained into $\frac{1}{30}$

According to the rule, $\frac{1}{30} \div \frac{1}{300} = \frac{1}{30} \times \frac{300}{1} = \frac{300}{30} = 10$

The tablet should then be dissolved in 10 c.c. of water thus preparing 10 doses. 1.0 c.c (m. xv) should be given every two hours, since every 1.0 c.c. contains gr. $\frac{1}{300}$.

CALCULATION OF DOSES FROM STOCK SOLUTIONS

In many institutions, for reasons of economy, many potent drugs which are used hypodermically are kept in solutions of various strengths. As a general rule, the more potent substances are kept in weak solutions (1% or less) and the less potent ones in stronger solutions. For example, strychnine sulphate is usually kept in 1% solutions and even in weaker solutions. Solutions of camphor or caffeine usually come in 20% or 25% solutions and even in stronger solutions.

In the calculation of doses from stock solutions the following facts may be emphasized. They are the elements upon which the calculations for such solutions are based.

1. In the following examples, the drop represents the drop obtained from a minim dropper and is therefore equal to **one minim.**

2. The fraction of a grain contained in one drop of a stock solution is always indicated by the percentage or ratio strength of the solution expressed in the form of a fraction. Thus one drop of a 1% solution contains gr. $\frac{1}{100}$, one drop of a 2% solution contains gr. $\frac{2}{100}$ or gr. $\frac{1}{50}$, one drop of a 20% solution contains gr. $\frac{20}{100}$ or gr. $\frac{1}{5}$, one drop of a 1:30 solution contains gr. $\frac{1}{30}$, etc.

For practical purposes we may classify all stock solutions in two groups:

(a) Relatively strong solutions.

(b) Relatively weak solutions.

The relatively strong solutions usually contain substances

that are administered in rather large doses; such as camphor, given in doses of grs. iii, grs. v, etc., caffeine, given in doses of gr. $\frac{1}{2}$, gr. i, etc.

The relatively weak solutions usually contain very potent substances that are administered in very small fractional doses, strychnine, given in doses of gr. $\frac{1}{60}$, gr. $\frac{1}{30}$, etc., atropine, given in doses of gr. $\frac{1}{120}$, etc.

Problem: To calculate the dose to be given from stock solutions of various strengths.

This may be done by the following two methods:

1. **The Division Method.**
2. **The Least Common Denominator Method.**

Every problem may be solved by either method. Practically, however, the division method is more applicable for the following problems:

(a) Calculation of large doses such as gr. $\frac{1}{2}$, grs. iii, grs. v, etc.

(b) Calculation of doses from solutions in which a given number of minims contain a definite dose; for example, when m. x contain gr. $\frac{1}{30}$.

The least common denominator method is more applicable for the calculation of small doses from relatively weak solutions, for example gr. $\frac{1}{150}$, gr. $\frac{1}{160}$, etc. For the calculation of such problems the advantage of this method is that it avoids working with fractions of a drop or fractions of a minim.

THE DIVISION METHOD

Rule: Divide the dose required by the fraction of a grain contained in one drop or minim of the stock solution. The result is the number of minims of stock solution to use.

Technique

(1) Pour the number of minims indicated by the result into a medicine spoon.

(2) Add enough sterile water to fill up a hypodermic syringe and give the dose to the patient.

Example: To give strychnine sulphate gr. $\frac{1}{25}$ from a 1% solution.

Since the stock solution is a 1% solution each drop will contain gr. $\frac{1}{100}$.

According to the rule, $\frac{1}{25} \div \frac{1}{100} = \frac{1}{25} \times \frac{100}{1} = \frac{100}{25} = 4$

We therefore give 4 minims or drops of the 1% solution which contain gr. $\frac{1}{25}$.

Example: To give gr. $\frac{1}{25}$ of strychnine sulphate from a solution of which m. x = gr. $\frac{1}{30}$

Since m. x = gr. $\frac{1}{30}$, each drop or

m. i, will contain $\frac{1}{10}$ of $\frac{1}{30}$ or gr. $\frac{1}{300}$

If each drop contains gr. $\frac{1}{300}$, gr. $\frac{1}{25}$ will be contained in as many drops as $\frac{1}{300}$ is contained in $\frac{1}{25}$ or,

According to the rule, $\frac{1}{25} \div \frac{1}{300} = \frac{1}{25} \times \frac{300}{1} = \frac{300}{25} = 12$

We therefore would have to give m. xii of the stock solution which contain gr. $\frac{1}{25}$.

Example: To give grs. iv of caffeine sodium benzoate from a 25% solution.

Each drop of a 25% solution contains gr. $\frac{25}{100}$, or gr. $\frac{1}{4}$ of caffeine sodium benzoate.

To give grs. iv therefore, we would have to give as many minims as $\frac{1}{4}$ is contained in 4, or,

According to the rule, $4 \div \frac{1}{4} = 4 \times \frac{4}{1} = 16$

To administer a dose of grs. iv of caffeine sodium benzoate we would give then, m. xvi of the 25% solution.

THE LEAST COMMON DENOMINATOR METHOD

(Author's Method)

The method may be illustrated by the following concrete example:

To give atropine sulphate gr. $\frac{1}{300}$ from a 1% solution.

Every drop or minim of a 1% solution contains gr. $\frac{1}{100}$. According to the method of division, dividing $\frac{1}{300}$ by $\frac{1}{100}$ we get $\frac{1}{3}$. We therefore have to give $\frac{1}{3}$ of a minim. We cannot obtain, however, the gr. $\frac{1}{300}$ in an even number of minims of the stock solution. We must then prepare another solution from which an even number of minims will contain the gr. $\frac{1}{300}$. This may be done by taking one drop of the 1% solution and adding two drops of water to it; thus diluting it twice. Each drop of such a solution will contain gr. $\frac{1}{300}$, consequently we take one minim of this solution for the desired dose.

By the least common denominator method we may determine in each problem the number of times a quantity of the stock solution is to be diluted. From this new diluted solution we can obtain the required dose in an even number of minims.

Rule

1. Reduce the smallest fraction of a grain contained in one minim or drop of the stock solution, and the dose to be given, to fractions with a least common denominator.

To Find the Dilution

2. Subtract the numerator of the fraction of a grain contained in a minim of the stock solution from the numerator of its equivalent fraction.

Add this number of minims of sterile water to one drop of the stock solution.

To Find the Number of Minims of the New Diluted Solution to Use

3. Of this new diluted solution give the number of minims indicated by the numerator of the least common denominator fraction formed from the required dose.

Technique

(1) Draw up some stock solution in a minim dropper, and pour one drop of it into a medicine spoon. (See illustration, Fig. 2.)

(2) To this drop, add as many drops of sterile water as the number of times it is to be diluted, as determined by solving the problem. (See illustration, Fig. 3.)

(3) Draw up some of this diluted solution in a minim dropper, and pour the number of drops needed (as determined by solving the problem) into another medicine spoon. (See illustration, Fig. 4.)

(4) Add enough sterile water to this quantity to fill up the hypodermic syringe, draw the fluid up into the syringe and administer the dose. (See illustration, Fig. 5.)

In giving doses less than that contained in one drop of the stock solution we always dilute **one drop** of the stock solution.

In giving doses greater than that contained in one drop of the stock solution we dilute **more than one drop.** (See page 72).

The following examples will illustrate the method:

Example: To give gr. $\frac{1}{200}$ of atropine sulphate from a 1% solution.

1. Each drop of the atropine sulphate solution contains gr. $\frac{1}{100}$.
2. The desired dose is gr. $\frac{1}{200}$.
3. The least common denominator of 100 and 200, is 200.

According to the rule,

$$*\frac{\triangle 1}{100} = \frac{\bigcirc 2}{200}*$$

$$\frac{1}{200} = \frac{\square 1}{200}*$$

One drop of the atropine solution must be diluted with one drop of water, since $\bigcirc 2 - \triangle 1 = 1$.

* △ encloses the numerator of the fraction of a grain contained in one drop of the stock solution.

○ encloses the numerator of the least common denominator fraction formed from the fraction of a grain contained in one drop of the stock solution.

□ encloses the numerator of the least common denominator fraction formed from the required dose.

(This makes a solution of which each drop contains gr. $\frac{1}{200}$.)

The number of drops of this diluted solution to use, is indicated by the numerator of $\frac{\boxed{1}}{200}$ formed from the desired dose, gr. $\frac{1}{200}$, which is 1.

We therefore take one drop of the atropine sulphate solution, add one drop of water to it, and from this we take **one drop** of the resulting solution. To this drop, add enough water to fill up a hypodermic syringe and administer to the patient.

Example: How would you give gr. $\frac{1}{150}$ of atropine sulphate from a 1% solution?

1. Each drop of the atropine solution contains gr. $\frac{1}{100}$
2. The desired dose is gr. $\frac{1}{150}$
3. The least common denominator of 100 and 150 is 300

According to the rule, $\frac{①}{100} = \frac{③}{300}$

$$\frac{1}{150} = \frac{\boxed{2}}{300}$$

Take one drop of atropine solution, add to that as many drops of water as the difference between the numerator of the dose contained in one drop of the stock solution $\frac{1}{100}$ (numerator = ①), and its equivalent fraction $\frac{3}{300}$ (numerator = ③) ③ − ① = 2. We therefore add 2 drops of water.

The numerator of $\frac{\boxed{2}}{300}$ formed from $\frac{1}{150}$, is the number of drops of the resulting solution to use. To this we add enough sterile water to fill up the hypodermic syringe and administer.

Example: To give gr. $\frac{1}{300}$ atropine sulphate from a $\frac{1}{2}$% solution.

Each drop of $\frac{1}{2}$% atropine solution contains gr. $\frac{\frac{1}{2}}{100} = \text{gr. } \frac{1}{200}$.

The least common denominator is 600.

According to the rule, $\frac{①}{200} = \frac{③}{600}$

$$\frac{1}{300} = \frac{\boxed{2}}{600}$$

Then take one drop of the $\frac{1}{2}$% atropine solution and add

METHOD OF PREPARING DOSES OF MEDICINES FROM STOCK SOLUTIONS

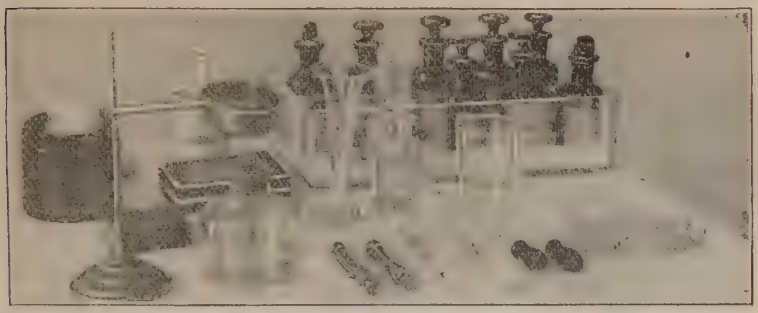


FIG. 1. Apparatus necessary for preparing and administering doses from stock solutions.

FIG. 2. Measuring the number of minims of stock solution.

FIG. 3. Adding the necessary number of minims of water, thus forming a new diluted solution.

FIG 4. Measuring the necessary number of minims of the new diluted solution.

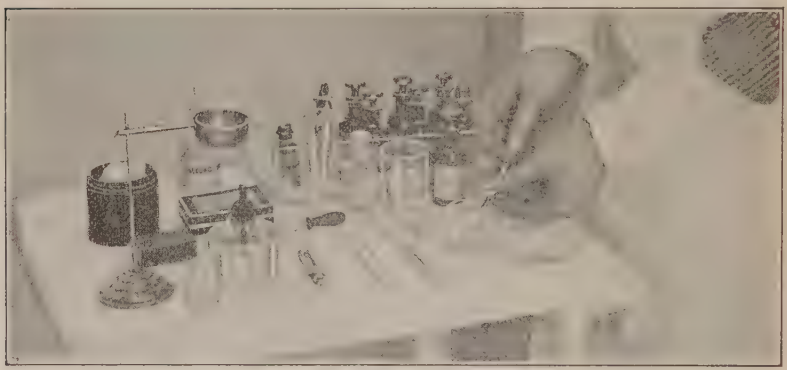


FIG. 5. Drawing up the number of minims to be administered into the hypodermic syringe.

FIG. 6. The correct way to give a hypodermic injection.
(Note the direction of the needle.)

FIG. 7. The wrong way to give a hypodermic injection.

two drops of water (③ − ① = 2) and take 2 (numerator of $\frac{\boxed{2}}{600}$, which is the same as $\frac{1}{300}$) drops of the resulting solution.

When the dose to be prepared is larger than that contained in one minim of the stock solution.

In doses larger than that contained in one drop of the stock solution, we find, that after taking one drop of the stock solution, and adding the necessary number of drops of water, the total quantity made up, is less than the number of drops of the resulting solution to use.

Example: To give gr. $\frac{1}{60}$ of strychnine sulphate from a 1% solution.

Each drop of a 1% solution contains gr. $\frac{1}{100}$ of strychnine. The least common denominator is 300.

According to the rule, $\frac{①}{100} = \frac{③}{300}$

$$\frac{1}{60} = \frac{\boxed{5}}{300}$$

③ − ① = 2, the number of drops of water to add.

We would then have to take 1 drop of the stock solution, and add 2 drops of water to it. Of this diluted solution we then take $\boxed{5}$ drops. But the total number of drops of the resulting solution is only 3, while the number to be used is 5, more than the total amount.

The object of taking 1 drop of the stock solution, and adding 2 drops of water, is to make up a solution, of which each drop shall contain gr. $\frac{1}{300}$ of strychnine, and then, instead of giving gr. $\frac{1}{60}$ of strychnine, we give its equivalent, gr. $\frac{5}{300}$, or 5 drops of the resulting solution.

Therefore, as long as we keep the same ratio between the stock solution and the quantity of water with which it is to be diluted, we will always have a solution of which each drop contains gr. $\frac{1}{300}$, no matter how much of such a diluted solution we prepare.

Instead then, of taking only **one drop** of the strychnine stock solution, and adding **two drops** of water, thus making up only three drops of a solution (of which each drop contains gr. $\frac{1}{300}$), we **multiply** the drop of the stock solution and

the number of drops of water to be added, each by 5, or 10, or any number which will make the total quantity of the resulting diluted solution more than the number of drops to administer. In this way, we make up a larger quantity of the same solution, each drop of which contains gr. $_3\frac{1}{0}\frac{}{0}$. In the example given above, if we multiply the number of drops of stock solution to use, and the number of drops of water to be added, each by 5, we make up 15 drops of a solution, each drop of which contains gr. $_3\frac{1}{0}\frac{}{0}$ of strychnine. 5 drops of this solution will contain gr. $_6\frac{1}{0}$ or gr. $_3\frac{5}{0}\frac{}{0}$ of strychnine.

When the dose to be prepared is larger than that contained in one minim of the stock solution:

Multiply the one drop of stock solution and the number of times it is to be diluted, each by any number which will make the total quantity of new diluted solution more than the number of minims to be given from it.

Example: To give gr. $_1\frac{1}{2}\frac{}{0}$ strychnine sulphate from a $\frac{1}{2}\%$ solution.

Each drop of the strychnine solution contains gr. $_2\frac{1}{0}\frac{}{0}$ of strychnine.

The least common denominator of 200 and 120 = 600.

According to the rule, $\frac{\triangle}{200} = \frac{③}{600}$

$$\frac{1}{120} = \frac{\boxed{5}}{600}$$

Take one drop of $\frac{1}{2}\%$ solution of strychnine, add (③ − △ = 2) 2 drops of water, and take $\boxed{5}$ drops of the resulting solution. Since the total quantity of the resulting solution is only 3 drops, we multiply the drop of stock solution, and the number of drops of water to be added, each by 3. We then take 3 drops of the $\frac{1}{2}\%$ solution of strychnine, and add to it 6 drops of water. Of this diluted solution we give the patient 5 drops.

Example: To give gr. $\frac{1}{75}$ of atropine sulphate from a solution of which m. v = gr. $\frac{1}{40}$.

Since m. v = gr. $\frac{1}{40}$, m. i = $\frac{1}{5}$ of $\frac{1}{40}$ = gr. $\frac{1}{200}$

Each minim of the stock solution contains gr. $\frac{1}{200}$ of atropine.

The least common denominator of 200 and 75 = 600

According to the rule, $\frac{\textcircled{1}}{200} = \frac{\textcircled{3}}{600}$

$$\frac{1}{75} = \frac{\boxed{8}}{600}$$

Take one drop of the atropine solution (stock) and add ③ − ① = 2 drops of water. Take [8] drops of the resulting solution. Since the total amount of the resulting solution is less than 8 drops, we multiply the drop of the stock solution, and the number of drops of water to be added, each by 4 (to make up a sufficiently large quantity). We then take 4 drops of the atropine solution, to which we add 8 drops of water. Of this diluted solution we take [8] drops, add enough sterile water to fill up a hypodermic syringe and give to the patient.

CALCULATION OF DOSES FOR CHILDREN

To determine the dose of a drug to be administered to a child, we fill in the known quantities in the following formula, and then calculate it. The result is the fraction of the adult dose to administer.

Young's Rule: Age of the child, divided by (age + 12) = the fraction of the adult dose, or,

$$\frac{\text{age}}{\text{age} + 12} \text{ of adult dose.}$$

For potent drugs, a slightly smaller quantity should be administered, and for some drugs a slightly larger dose should be administered.

Example: How much aspirin should be given to a child 3 years old? (Adult dose of aspirin = grs. v.)

$$\text{Age of child} = 3$$

$$\text{then, } \frac{3}{3 + 12} = \frac{3}{15} = \frac{1}{5}$$

We therefore give the child $\frac{1}{5}$ of grs. v or gr. i of aspirin.

SUMMARY OF CALCULATION OF DOSES

In preparing doses of potent drugs for hypodermic or internal use, the calculation of the problems will be facilitated by handling them in the following systematic manner:

Before solving each problem the nurse should determine:

1. Whether the dose is to be calculated from a tablet.
2. Whether the dose is to be calculated from a stock solution.

If the dose is to be calculated from a tablet the problem should be solved according to Rule 1, page 63.

If the dose is to be calculated from a stock solution, **the division method** may be used for the following problems:

(a) Large doses from stock solutions of more than 1%.

(b) Fractional doses from solutions of which a definite number of minims contain a definite dose.

The least common denominator method may be used for the following problems:

(a) For all doses to be calculated from all relatively weak solutions such as 1% solutions or less.

(b) For calculating fractional doses from solutions of which a definite number of minims contain a definite dose.

It should be remembered, however, that all problems from stock solutions may be solved by either method.

The calculation of doses will lose its terrors if the nurse remembers the rules to be applied in each particular case and the reasons underlying them. It must be emphasized, however, that one can become expert only by constant practice in solving many and varied problems.

TABLE OF USUAL STRENGTHS OF COMMONLY USED SOLUTIONS FOR INTERNAL USE

Name of Solution	Percentage of Solution	Quantity to Ounce
Ammonium Bromide	25%	ʒii
Ammonium Iodide	50%	ʒiv
Aromatic Spirits of Ammonia	4%	grs. x
Arsenious Acid Solution	1%	grs. v
Caffeine Sodium Benzoate	25%	ʒ ii
Camphor Oil	20%	ʒ i½
Camphor Spirits	10%	gr. l
Camphor Water	0.8%	gr. i½
Dilute Acetic Acid	6%	m. xxx
Dilute Hydrochloric Acid	10%	m. l
Dilute Hydrocyanic Acid	2%	m. x
Dilute Nitric Acid	10%	m. i
Dilute Nitrohydrochloric Acid	20%	ʒi²/₃
Dilute Sulphuric Acid	10%	m. l
Diuretin Solution (Theobromine Sodium Salicylate)	25%	ʒ ii
Epinéphrine Chloride (Adrenalin Chloride)	0.01% (1–1000)	gr. ½
Fowler's Solution of Arsenic (Liquor Potassii Arsenitis)	1%	grs. v
Homatropine Hydrobromide	2%	grs. x
Mercury Salicylate	0.02% (1–5000)	gr. 1/10
Morphine Sulphate (Magendie's Solution)	3%	grs. xv
Nitroglycerine solution	1%	grs. v
Paregoric (Tinct. Opii. Camphorata)	0.4%	grs. ii
Potassium Iodide Solution (Saturated)	100%	℥i
Potassium Iodide Solution	50%	℥½
Sodium Bromide	50%	ʒiv
Sodium Iodide Solution	50%	℥½
Spirits of Chloroform	10%	m. l
Spirits of Ether	30%	ʒii½
Spirits of Ether (Compound)	30%	ʒii½
Strontium Bromide	50%	ʒiv

PROBLEMS

Doses from Tablets

How would you calculate and prepare the following doses:

1. Strychnine sulphate gr. $\frac{1}{50}$ from tablets of gr. $\frac{1}{30}$.
2. Eserine salicylate gr. $\frac{1}{30}$ from tablets of gr. $\frac{1}{40}$.
3. Atropine sulphate gr. $\frac{1}{50}$ from tablets of gr. $\frac{1}{100}$.
4. Atropine sulphate gr. $\frac{1}{120}$ from tablets of gr. $\frac{1}{100}$.
5. Atropine sulphate gr. $\frac{1}{60}$ from tablets of gr. $\frac{1}{100}$.
6. Heroin hydrochloride gr. $\frac{1}{8}$ from tablets of gr. $\frac{1}{3}$.
7. Strychnine sulphate gr. $\frac{1}{20}$ from tablets of gr. $\frac{1}{60}$.
8. Pilocarpine hydrochloride gr. $\frac{1}{5}$ from tablets of gr. $\frac{1}{8}$.
9. How many doses of strychnine sulphate gr. $\frac{1}{400}$ can you prepare from a tablet of gr. $\frac{1}{60}$, and how would you give this dose accurately each time?
10. How many doses of atropine sulphate gr. $\frac{1}{250}$ can you prepare from two tablets of gr. $\frac{1}{120}$, and how would you give an accurate dose each time?

Doses from Stock Solutions

How would you calculate the required dose from the stock solution in each of the following problems:

1. Caffeine Sodium Benzoate grs. vi from a 25% solution.
2. Camphor grs. v from a camphor liniment.
3. Sodium bromide grs. xv from a 25% solution.
4. Potassium iodide grs. xx from a saturated solution, and from a 50% solution.
5. Morphine sulphate gr. $\frac{1}{4}$ from a 1 : 30 solution.
6. Strychnine sulphate gr. $\frac{1}{30}$, gr. $\frac{1}{15}$, gr. $\frac{1}{60}$, gr. $\frac{1}{150}$, gr. $\frac{1}{200}$, gr. $\frac{1}{175}$ from a 1% solution.
7. Eserine salicylate gr. $\frac{1}{60}$, gr. $\frac{1}{40}$ from $\frac{1}{2}$% solution.
8. Strychnine sulphate gr. $\frac{1}{30}$, gr. $\frac{1}{50}$, gr. $\frac{1}{80}$, from a solution of which m. x contain gr. $\frac{1}{50}$.
9. Atropine sulphate gr. $\frac{1}{120}$, gr. $\frac{1}{250}$, from a $\frac{1}{2}$% solution.
10. Morphine sulphate gr. $\frac{1}{4}$, gr. $\frac{1}{8}$, gr. $\frac{1}{10}$, gr. $\frac{1}{20}$ from Magendie's solution.
11. Atropine sulphate gr. $\frac{1}{160}$, gr. $\frac{1}{120}$, gr. $\frac{1}{200}$ from a solution of which m. v contain gr. $\frac{1}{30}$.
12. Atropine sulphate gr. $\frac{1}{120}$ from a solution of which m. x contain gr. $\frac{1}{150}$.
13. Eserine sulphate gr. $\frac{1}{60}$, gr. $\frac{1}{40}$, gr. $\frac{1}{75}$ from a $\frac{1}{4}$% solution.

14. Strychnine sulphate gr. $\frac{1}{30}$, gr. $\frac{1}{60}$, gr. $\frac{1}{120}$, gr. $\frac{1}{150}$ from a 1 : 300 solution.

15. Nitroglycerine gr. $\frac{1}{150}$, gr. $\frac{1}{100}$, gr. $\frac{1}{75}$, gr. $\frac{1}{50}$ from a 1% solution.

Doses for Children

In each of the following examples, how much of the adult dose would you give:

(1) Caffeine Citrate to a 4 year old child (adult dose is gr. i).

(2) Morphine Sulphate to a 6 year old child (adult dose is gr. $\frac{1}{4}$).

(3) Tincture of Digitalis to a 10 year old child (adult dose is m. x).

(4) Atropine Sulphate to a 2 year old child (adult dose is gr. $\frac{1}{60}$–$\frac{1}{120}$.)

(5) Compound Licorice Powder to a 6 year old child (adult dose is ʒ i).

Miscellaneous

In each of the following problems indicate the methods to be used:

1. How would you give Caffeine Sodium Benzoate gr. ii from a 40% solution?

2. How would you give Atropine sulphate gr. $\frac{1}{60}$ from a $\frac{1}{2}$% solution?

3. Eserine salicylate gr. $\frac{1}{40}$ from a tablet of gr. $\frac{1}{60}$.

4. Strychnine sulphate gr. $\frac{1}{20}$ from a solution of which m. v contain gr. $\frac{1}{15}$.

5. Codeine sulphate 0.008 gm. from a 1 : 50 solution.

CHAPTER V

THE ADMINISTRATION OF MEDICINES

The administration of medicines is perhaps the most important branch of Materia Medica for the nurse. The physician is usually content merely with ordering remedies to be given. The effect of drugs, however, may frequently depend upon the method in which they are given, the care with which they have been kept and the accuracy with which the doses are prepared.

Even in hospitals, where a relatively ideal condition for nursing exists, the methods for the administration of medicines may be based on more or less empiric rules. These methods are handed down from nurse to nurse until they may assume a local color, which accounts for the variety of the methods extant in similar equally efficient institutions.

In this chapter we shall discuss the methods of administration according to more or less definitely established scientific principles insofar as our present knowledge of the action of drugs permits us to do so. Before taking up the administration of medicines proper, it is important for the nurse to have a definite idea of the methods of caring for and handling remedies so as to prevent deterioration, which may interfere with the production of desired results. She should thoroughly familiarize herself with the physical and chemical properties of the medicines she is using either in the ward or when on private duty. She should develop certain habits of precision in preparing doses to such an extent that they should become her second nature.

CARE OF MEDICINES

1. All medicines should be kept in a special medicine chest.

2. It is customary to assign the care of the medicine closet to one nurse. The closet should always be kept locked

and the key held by the nurse in charge, who should see that every commonly used substance is always in stock.

4. All bottles, boxes, etc., should be appropriately marked with labels which are not apt to fall off. The remedies should be arranged in the closet alphabetically in systematic order. The following order is suggested:

(a) Substances used externally should be kept together; solids and liquids in separate compartments.

(b) Substances for internal use should be grouped together; solids and liquids in separate compartments.

(c) Stimulants and all potent remedies such as morphine, etc., should be kept in a compartment by themselves, adjacent to the hypodermic tray, which should always be ready for use.

(d) All poisons should be labeled "Poison." They should be kept in distinctive bottles, such as blue rough bottles, and kept together in a separate compartment.

(e) Oils should be kept in a cool place, since they readily decompose.

5. The nurse in charge of the medicine closet should examine the contents of the closet daily. She should order whatever is needed in small quantities and examine the character of all the medicines.

6. The change in color, consistency or odor of any substance should be reported to the physician or pharmacist and if this has interfered with its efficiency a fresh supply should be obtained.

7. Every bottle of medicine should be corked and immediately replaced after use.

CARE OF APPARATUS

1. All apparatus should be kept together.

3. Weights should be kept clean by dusting, not by polishing.

2. Balances should always be kept covered.

4. Test the balance before use.

5. For measuring fluids glass utensils should be used.

ACCURACY

While preparing medicines the nurse should concentrate her entire attention upon the work. She should not be disturbed by other duties.

1. When calculating doses be sure your answer is correct; verify it if in doubt.

2. Familiarize yourself with the smallest and largest doses of the remedies you are giving. If you think the maximum dose has been exceeded always verify it.

3. Always look **three** times at the label of every bottle or box before using any of its contents: when taking it from the closet, when removing the contents, and when returning the bottle or box to the medicine closet.

4. Never use medicines from an unmarked bottle, or when you are in doubt as to the nature of the contents.

5. When pouring fluids, hold the bottle with the label pointing upwards so as to avoid soiling it.

6. Measure the quantities as ordered; do not give a teaspoonful when a dram is ordered and vice versa. Measure the quantities with graduated measuring glasses or marked glass spoons. Do not use household utensils unless the others are not available.

7. When measuring fluids hold the graduate so that the surface of the fluid, which is usually curved, is on a level with the eye. The quantity is read when the lowest part of this curve is on a line with the mark of the desired quantity, thus:

8. Never pour a medicine back into the bottle.

9. A medicine which forms a precipitate with another substance should always be given alone. Such medicines are said to be **incompatible.**

10. All the medicines being administered in the ward should be listed. There are several methods of doing this The most common one is to have a distinctive color for the various times of administration. These are placed on a

board near the medicine chest, together with the names of the patients.

11. All medicines should be appropriately marked as soon as prepared.

12. Give all medicines at the times ordered; b. i. d. medicines should be given at 8 A. M. and 6 P. M., t. i. d. medicines should be given at 8 A. M., 12 M. and 6 P. M.

13. Always stand at the patient's bedside until the medicine is taken.

14. Never allow one patient to administer medicines to another.

THE PRINCIPLES OF ADMINISTRATION

Drugs are given to cause local or general effects, or both. **Local effects** result from a direct application of a substance to a tissue or organ, thus changing its structure or function.

General or systemic effects result when a drug enters the blood stream and affects tissues or organs remote from the site of application.

It is frequently essential for the nurse to know the effect that is desired, as the method of administration may vary accordingly.

ADMINISTRATION FOR LOCAL EFFECTS

For a local effect it is merely desired to bring the remedy in contact with a diseased tissue or organ. As a rule, the more prolonged the contact the greater is the effect. Local remedies are usually applied in the following forms:

- Solutions
- Liniments
- Ointments
- Oleates
- Cerates
- Poultices
- Plasters

} Applied only on skin

- Powders
- Lozenges
- Bougies
- Suppositories

Administration of Solutions

Substances are usually applied locally in solutions for their antiseptic effect: to check the growth of bacteria. The longer the solution is in contact with the wound the greater is the antiseptic action. The solution must be changed frequently, however, since the effect soon wears off.

The best antiseptic action is obtained by keeping the wound in a continuous bath of the solution; which is not always possible, however.

Other Methods of Applying Solutions

Wet Dressings

The most common way in which antiseptics are applied is by means of gauze which has been soaked in the required solution. The dressings are kept moist by frequent changing or by covering with rubber tissue. Frequent changing is the better method since it not only keeps the dressings moist but drains the secretions and keeps the wound dry.

Administration of Douches

Solutions used as douches are given for their antiseptic or constricting (astringent) effect on the mucous membrane of the vagina and cervix, and to remove accumulated secretions. Douches are also given to check bleeding from the uterus or cervix, and to lessen pain produced by their contraction. Contact with the diseased tissues is essential for the effect. It is especially important that every part of the vaginal fornix be irrigated to remove the secretions which usually accumulate in these regions.

Method: The patient should lie flat on the back with the thighs and legs flexed and a pillow underneath the buttock. The sterilized nozzle is then inserted far back into the vaginal fornix. The fluid is allowed to run from the bag held about two feet above the patient, and the nozzle gently moved about to distribute the fluid over the entire mucous membrane.

For an antiseptic or an astringent effect, or for drainage, the temperature of the fluid should be that of the body, about 100° F. To check bleeding or to lessen pain, solutions should be as hot as the patient can stand.

Administration of Mouth Washes and Gargles

Mouth washes and gargles are used for diseased conditions of the mouth and throat: to cause an antiseptic or a constricting (astringent) effect. In administering mouth washes and gargles it is essential to bring the drug in contact with every part of the lining membrane of the mouth and throat. This is usually accomplished by keeping the fluid in the mouth and moving it about by means of a current of expired air.

Fluids applied in this manner do not affect the tonsils or pharynx to any extent, since they do not reach back far enough. Local applications to these tissues are best applied by sprays or irrigations.

Irrigation is a very good method for applying medicines to the throat. It is usually done by means of a glass nozzle attached to an irrigating bag, with the patient lying down, the head on the side and the mouth and chin slightly tilted forward.

Administration of Liniments

Liniments are usually applied for their soothing effect. They should be applied on a piece of flannel or lint which keeps the skin warm, prevents evaporation of the liniment and thereby helps the action. Many liniments are applied by vigorous rubbing. Whatever effect is then produced is due principally to the vigorous massage and very little, if any, to the liniment itself.

Administration of Ointments

Ointments may be applied for a local or a general effect. They are the best means of applying remedies for a prolonged local effect. The fat in which the drug is contained dissolves readily but does not evaporate, thus prolonging the effect of the drug on the site of application.

The ointment should be spread on a piece of flannel or lint and applied to the site ordered; it should be changed frequently; about every day. Ointments should be avoided on discharging wounds as they prevent free drainage of the

secretions. For a general effect they are applied by rubbing. See page 102.

Oleates and Cerates are administered like ointments.

Administration of Poultices and Plasters

Poultices and plasters are usually applied to produce the following effects:

1. To relieve pain.
2. To dilate the blood vessels of the skin (rubefacient action). Blood is thus brought to the surface from the deeper tissues or organs, relieving congestion and inflammation of many organs. Poultices or plasters cause other reflex effects. (See Counterirritants.)
3. To produce blisters. This is merely an exaggeration of the rubefacient effect as the result of a prolonged application or of a stronger preparation.

Poultices are usually diluted with flour until the desired strength is obtained. They are moistened and wrapped in a piece of gauze or lint and applied to the site ordered.

Plasters should be moistened in lukewarm water before being applied.

Poultices or plasters should remain on the skin for ten to twenty minutes to induce a rubefacient action and longer for the formation of a blister. The nurse may vary the duration of the application, however, so as to obtain the desired effect. Some plasters such as mercury plaster may be kept on the skin for days.

Other Forms of Local Administration

Powders are usually dusted over the surface of a wound or ulcer.

Lozenges are kept in the mouth; they are dissolved by the saliva, and the medicinal substances which they contain then affect the mucous membrane of the mouth.

Bougies are long thin medicated tubes, made with wax. They dissolve in mucous membrane lined cavities, and then produce either local or general effects.

Suppositories are cone-shaped preparations of drugs made with cocoa butter, and are applied in the same manner as bougies.

ADMINISTRATION FOR GENERAL OR SYSTEMIC EFFECTS

When a remedy is given for a general or systemic effect, to act upon organs and tissues remote from the site of application, the drug must enter the blood stream. Thus it will reach, through the circulating blood, the organ or tissue for which it has a selective action and induce the desired effects. By the chemical combination of the drug with some of the constituents of the cells of these organs, certain desired changes in the activity of the organs are brought about. For example, when a dose of morphine sulphate is given to a patient to relieve pain, the dose is dissolved in the gastric juice and passes through the mucous membrane of the stomach into the blood stream. Here it is carried by the moving stream until it reaches the cells of the gray matter which are selectively affected by the morphine. It then affects the areas in the brain which appreciate pain. A chemical combination of the morphine and some of these cells probably occurs, thus lessening their function and pain is therefore not appreciated.

The simplest way in which general effects are produced is by directly injecting the drug into one of the veins. The following are the methods used for administration for general effects arranged in the order of the rapidity with which the effects are produced:

1. **Intravenous method**
2. **Intramuscular method**
3. **Hypodermic method**
4. **By mouth**
5. **By rectum**
6. **By the skin**

Intravenous Administration

Intravenous Injection

The median basillic or median cephalic vein of the front of the elbow is the most suitable vein for injecting drugs. A rubber or gauze bandage is tightly wound around the middle of the arm and the hand is gripped firmly while the

forearm is extended. The vein is thus made to stand out prominently. The surface of the skin over the vein is then sterilized with green soap, 50% alcohol and a 1:2000 bichloride of mercury, or the site may be painted with tincture of iodine.

A sterilized hypodermic syringe is now filled with a sterile solution of the drug to be injected, and the air expelled from the syringe. The needle is then inserted into the vein pointing it toward the heart and a few drops of blood slightly withdrawn from the vein. When blood enters the syringe you are sure the needle is in the vein.

The bandage of the arm may now be loosened and the solution of the drug should be injected very **slowly.** Slow injection is very important, as serious, even fatal results have occurred from too rapid injection.

Intravenous Infusion

The arm is prepared as for an intravenous injection. The fluid is made up in a special sterile glass jar which is placed on a stand above the level of the patient. To this glass jar is attached a rubber tube and a needle, or cannula. The needle is inserted into the vein, pointing it toward the heart and the fluid is then allowed to flow. If a cannula is used, the vein must be exposed, opened, and the cannula inserted into the open vein in a direction toward the heart. The effects of an injection appear almost immediately.

Intramuscular Administration

The site for an intramuscular injection is usually one of the buttocks, or the front of one of the thighs. The skin over the site of injection is sterilized in the usual manner. A sterilized hypodermic syringe is filled with a well diluted solution of the drug to be injected and fitted with a large firm needle. The needle is then inserted perpendicularly into the muscles. The syringe may now be withdrawn or slightly aspirated. If blood is obtained a new site must be chosen as the needle has probably been stuck into a vein. If no blood is obtained the solution may be injected, but very slowly; and the area of injection should then be

thoroughly massaged and covered with a little collodion or some other dressing.

Hypodermic Administration

The best sites for hypodermic injection are the front of the thighs, the outer part of the arms and forearms. The skin at the site of injection should be sterilized by rubbing with 50% alcohol. The sterilized syringe is now filled with a well diluted solution of the drug to be given and held in the right hand with the neck of the syringe resting between the index and middle finger with the thumb on the piston. The skin at the site of injection is then taken between the thumb and index finger of the left hand and the needle inserted under the skin at an angle of about 45 degrees. The place of injection should then be thoroughly massaged.

In giving a hypodermic injection it is very essential to inject the drug **under** the skin, not into the skin. When the drug has been injected into the skin the area of injection looks like goose skin and the needle should be withdrawn and a new place chosen. This should be sterilized and the injection repeated.

The effects of a hypodermic injection usually appear in about ten minutes to a half hour, depending upon the patient's circulation; the better the circulation the more rapid are the effects.

It may also be noted that the more the drug is diluted the better and the more rapid are the effects following a hypodermic injection.

ADMINISTRATION BY MOUTH

The most common way in which medicines are given is to let the patient drink a fluid which contains the medicine, or to swallow it in the form of a pill, capsule, etc.

In administering any remedy the nurse should consider the following points:

1. **Absorption**
2. **Desired effect**
3. **Taste**
4. **Time of administration**

Absorption

Absorption is the process whereby a drug enters the blood stream, by passing through the lining membrane of the stomach or intestines or from the tissues.

Except in the case of acids, alkalies, salts, and a few other substances, our knowledge of the absorption of remedies is as yet very meager. Most drugs are absorbed in the stomach and intestines but in their own particular way. Some drugs are readily absorbed while others are not absorbed at all. However, we do know that they are all chemical substances and must therefore follow definite chemical laws.

Physical Chemistry of Remedies and Absorption

Let the reader picture to herself what happens to any remedy when it is given by mouth. As soon as it enters the stomach, no matter whether it is given in fluid or solid form, it becomes dissolved in the gastric juice, and in many instances in the intestinal juice. Some remedies may be digested by the gastric or intestinal juice, but their condition will not be changed except that they are decomposed into simpler substances. The fate then, of any remedy when dissolved in either the gastric or intestinal juice will depend upon the innate absorbability of the substance and upon the laws of physical chemistry governing solutions. These laws have been definitely determined in the case of such simple substances as acids, alkalies and salts. Since other absorbable substances can only be absorbed when they are in solution, they should be administered in the same way in which we know the absorption of the salts, acids and alkalies is increased.

Chemistry of Solutions

Any substance when dissolved is capable of undergoing the following changes:

1. **Diffusion.** This is a process whereby one fluid is able to pass into another. Usually the more concentrated solution passes into the less concentrated one, until each contains the same ingredients in a similar concentration. It is by such a

process that substances are able to dissolve, and it is by the same process that medicinal substances are enabled to mix with the gastric or intestinal juice and vice versa. **As a rule, the more diffusible substances are more readily absorbed.**

2. **Osmosis:** This is a property whereby one solution is able to penetrate into another through an animal membrane. The stronger solution usually withdraws fluid from the weaker one until both fluids contain the same substances in the same concentration. The passage of various salt solutions from the intestines into the blood stream and the withdrawal of fluid from the blood are due to such a process. As a rule, **a solution which is more dilute, and therefore has less osmotic power is more readily absorbed.**

Dissociation: This is a process whereby many salts, acids and alkalies dissolved in a fluid will separate into two groups of atoms which are capable of carrying electricity. Each group of atoms is called an ion and consists of one or more atoms. The group charged with positive electricity is called a **cation,** and the one charged with negative electricity is called an **anion.** An ion differs from an atom in the following ways: It is charged with electricity and consists of one or more atoms. Substances occur as ions only when they are dissolved, and not when in the solid state.

For example, when we dissolve sodium chloride in water, it soon becomes separated (dissociated) into groups of atoms of sodium, which are charged with positive electricity (sodium cations) and groups of atoms of chlorine which are charged with negative electricity (chlorine anions).

Substances which are in solution and which exist in the state of ions are more readily absorbed, are capable of inducing the greatest degree of chemical action and therefore produce better pharmacological effects. In the blood the salts always exist in the form of ions.

Factors Influencing Dissociation:

The degree and rapidity with which a substance will dissociate into its ions depend upon the character and quantity of the fluid in which it is dissolved.

The character of the solvent: Water and weak acids are

the fluids in which substances dissociate most readily into their ions.

For practical purposes, water is the fluid in which dissociation takes place most readily. The degree of dissociation in other fluids depends upon the percentage of water they contain. Thus substances will dissociate most readily in alcoholic beverages that contain the smallest percentage of alcohol. In syrups, in oils and in colloids (albuminous fluids) such as milk, dissolved substances separate very slowly into ions, if at all.

The quantity of fluid: The greater the quantity of fluid in which a substance is dissolved and therefore the more dilute the solution up to a strength of about 1 : 1000 the greater is the degree of dissociation of the dissolved substance in it. When this dilution is reached the degree of dissociation does not increase.

Dissociating power of various drugs: Some substances dissociate into ions, others do not. Acids and many absorbable salts dissociate most readily. Of the substances that do dissociate, the more simple inorganic chemical substances separate more readily into their ions than the more complex organic ones. Whatever power of dissociation each substance has, however, may be increased by dissolving it in a large quantity of water.

How to Aid Absorption

The following facts based upon the foregoing principles will enable the nurse to administer most drugs so as to increase their absorption.

(1) Any substance usually given to produce a general effect is capable of being absorbed.

(2) Substances that are capable of being absorbed can only be absorbed when dissolved in a fluid (before administration or in the stomach or intestines).

(3) In administering a remedy the greatest degree of absorption of which it is capable will be brought about when it is given in a medium in which most absorption can take place.

The following is a list of fluids in which medicines are commonly given, arranged according to the rapidity with

which they are absorbed and according to the degree with which they separate dissolved substances into their ions.

1. Water
2. Weak acids
3. Alcoholic beverages
4. Syrups
5. Oils
6. Colloids (albuminous solutions)

(4) A substance is absorbed most readily when it is dissolved in water. With the possible exception of lemonade and grape juice weak acids are seldom used as mediums in which to administer medicines.

(5) Alcohol and oils will aid the absorption of whatever substances may be dissolved in them, because they themselves are easily absorbed, although dissociation does not readily occur in such fluids.

(6) The larger the quantity of fluid in which a substance is dissolved the more readily will the dissolved substance be absorbed, because in a dilute solution a substance is readily diffusible and has a low osmotic power. Better pharmacological effects will be obtained from such a solution because dissolved substances dissociate readily in it and are, therefore, more active.

(7) More absorption takes place after meals than before meals, because the stomach and intestines are supplied with more blood at that time and the capillaries and lymphatics are widened.

(8) Substances which combine with foods cannot be absorbed, until the chemical combination is broken down by the digestion of the food.

(9) In general, simpler inorganic substances are absorbed more readily than the more complex organic ones. However, some substances are readily absorbed while others are not. There is no rule to determine this.

Desired Effect

In administering medicines by mouth it is often essential for the nurse to know whether a local or a general effect is

desired. For a general effect absorption should be aided and for a local effect it should be lessened.

Taste

Taste is a very important factor from the patient's standpoint. A patient may dislike a remedy because of its bitter, bland or unpleasant taste. The bitter taste is often necessary for the effect and should not be disguised. When the unpleasant taste is not necessary for the effect it may be lessened by giving the remedy in a large quantity of fluid or in syrup, wine or jam.

Oils such as castor oil should be given in the form of a cocktail or as an emulsion with lemon, orange, or grape juice. Very small quantities of an oil should be given on a lump of sugar or in melted butter.

The taste of powders may be disguised by placing the powder in a capsule, cachet or konseal or by wrapping it in a small disk of rice paper.

Unpleasant tasting fluids should be given cold, followed by a copious drink of water.

Time of Administration

The time to administer most remedies is not as important as patients frequently imagine. For certain effects, however, certain times of administration are preferable to others.

Remedies should be given **before meals** for the following effects:

1. To aid the appetite or to increase the secretion of digestive juices.

2. For a local effect on the stomach or intestines. When the substances are irritating they should be given in milk. The combination of the remedy with the protein of the food lessens the irritation.

Remedies should be given **after meals**, for the following effects:

1. To neutralize digestive juices when these are present in excess.

2. To aid absorption and produce rapid effects.

3. Remedies which are given for absorption, but which are irritating to the tissues. The irritation is lessened by the combination of the remedy with the protein of the food.

Cathartics should be given **between meals** on an empty stomach. Those acting slowly should be given at night. Those acting quickly should be given in the morning.

Rules for Administration by Mouth

1. For a rapid general effect give the substance diluted in a large quantity of water immediately after meals, thus aiding absorption.

2. For a slow gradual general effect give substances in small quantities of syrup, milk or wine between meals, to retard absorption.

3. For a local effect on the stomach or intestines give the substance in acacia or mineral oil, thus lessening absorption.

4. Taste and time as indicated above.

Protection of Mouth and Teeth

Remedies which are injurious to the teeth such as iron or acids should be given through a glass tube or straw.

Administration to Children

To children medicines should always be given in fluid form. Special care should be taken to thoroughly disguise substances having an unpleasant taste. Pills, tablets or capsules should not be given to children as they are apt to chew these preparations before swallowing them.

Administration to Unconscious or Insane Patients

Unconscious or insane patients who are unwilling to take medicines should be given substances only in fluid form. The medicine should be dropped on the back of the tongue with a small spoon. To insane patients it is frequently necessary to administer medicine through a narrow stomach tube passed through the nose.

ADMINISTRATION OF VARIOUS REMEDIES

Administration of Acids

The dilute acids are usually given to replace acid in the stomach when its secretion is diminished. They may injure the enamel of the teeth, so that they must be given through a glass tube or straw. In giving acids an attempt should be made to imitate the normal secretion of acid in the stomach. This is best accomplished by dissolving the dose in a large quantity of water and allowing the patient to sip it slowly through a glass tube or straw.

Administration of Inorganic Salts

Inorganic salts are of two kinds: alkaline * and metallic. The alkaline salts that are not readily absorbed are used to neutralize excessive acid in the stomach and as carthartics, while those that are readily absorbed are used as diuretics. Of the metallic salts, mercury, iron and arsenic are the ones commonly used for absorption. The others are occasionally used, but only for their local effects.

Saline Cathartics: Most of the salts used as cathartics are not readily absorbed, even when given in very dilute solutions. They usually act merely by withdrawing fluid into the intestines from the tissues and blood. The more concentrated the salt solution, that is, the greater its percentage of salt than the blood, the more is the quantity of fluid withdrawn. When enough fluid passes into the intestines to distend them, bowel movements result. Practically, with concentrated solutions this takes quite some time, but with dilute solutions it occurs more rapidly. It is therefore better to give saline cathartics in dilute solutions; that is, in one or two tumblerfuls of water, before breakfast, when the stomach is empty, to avoid chemical combinations with the food.

To remove fluids from the tissues to relieve oedema, salts should be given concentrated, very slightly diluted, since they will then withdraw more fluid.

Saline Diuretics: The salts given as diuretics are usually readily absorbed. Only part of the salt, however, is ab-

* For administration of alkalies and alkaline salts, see page 100.

sorbed, but a sufficient quantity to act upon the kidneys. Saline diuretics should be given in a large quantity of water, in one or two tumblerfuls, between meals.

Metallic Salts: The metallic salts dissociate rapidly into their ions, but they combine readily with the proteins of the cells of the mucous membrane of the stomach and intestines with which they come in contact. If this chemical combination takes place to any degree, the cells become injured. This irritation is responsible for the symptoms of poisoning, such as vomiting, diarrhoea, etc., that follow the use of many metals. When the albuminate formed by the combination of the metal and the cells dissolves readily in the excess of fluid protein with which the body cells are constantly bathed, the metal is absorbed and general or systemic symptoms result. This is the case with substances such as mercury, iron and arsenic which are usually given for their general effects. Absorption of these salts may be increased then, by giving them in a large quantity of a fluid, such as milk. In such a fluid the metal readily combines with the proteins, the irritation is avoided, and at the same time absorption is aided.

For a local effect, the metallic salts should be given in smaller quantities of a similar fluid, but between meals; since there is not as much absorption from smaller quantities of fluid, and at this time. The salts commonly given for local effects are the preparations of bismuth.

The organic preparations of the metals are already combined with an albumin. The metals that are absorbable are therefore more readily absorbed while those that are not usually absorbed are less irritating.

The Iodides and Nitrites: The iodides and nitrites also dissociate very readily and combine rapidly with the albumins of the cells of the stomach and intestines. This accounts for the pain in the region of the stomach which occasionally follows the use of such preparations as potassium iodide. To lessen the irritation, the iodides should be given in a glass of milk after meals. A little wine, sarsaparilla or cinnamon water may be added to disguise the salty taste.

Administration of Alkaloids and Their Salts

The alkaloids themselves do not dissolve readily and are therefore not absorbed. They are usually given, however, in the form of salts which they readily form with acids. Some of the salts, such as hydrochlorides and sulphates, are absorbed more readily than others. These salts are therefore preferable for rapid effects.

The alkaloids should always be given in a large quantity of water (about a wineglassful to half a tumblerful), so as to increase the absorption. They have a bitter taste, however, which may be lessened by adding a little syrup, raspberry juice or cinnamon water.

It has long been known empirically that very dilute solutions of the salts of the alkaloids are the most efficient preparations. For example, the efficiency of Magendie's solution of morphine sulphate is due to the fact that it is a dilute 1 : 30 watery solution which is rapidly absorbed.

Administration of Glucosides

Most of the glucosides are relatively insoluble substances and are therefore, not readily absorbed. They are slowly absorbed, however, from many of the galenical preparations of their crude drugs such as tinctures, infusions, fluidextracts, etc. We shall consider the administration of these substances together with the other galenical preparations. There are, however, a number of new preparations of glucosides which have been made soluble, such as those of digitalis. Of these, perhaps the most commonly used preparations are digalen, strophantin, and ouabain. These are usually given for rapid effects and should be administered in about a wineglassful of water flavored with just a little syrup.

Administration of Galenical or Physical Preparations

The galenical preparations are made from the crude drug by purely physical means. They are the extracts, tinctures, infusions, fluidextracts, etc. These preparations contain

the crude drug in a more or less diluted form. The fluid preparations are more active than the solid ones.

The galenical preparations should always be given well diluted in a wineglassful to a tumblerful of water. The preparations which have an unpleasant taste may be given in diluted syrup, raspberry juice or wine.

The effects of the physical preparations appear very slowly because their active principles are but slowly absorbed from the preparations.

Administration of Hypnotics

Most of the drugs used as hypnotics are substances of a comparatively complex chemical structure and are slowly absorbed. They are usually given for effects that are to last for several hours. They should be administered in a tumblerful of warm milk or beer, about a half to two hours before the usual bedtime, the actual time depending on the rapidity with which the particular drug is absorbed.

The slow absorption of a substance such as sulphonal may be somewhat increased by giving it in milk well diluted with water.

The nurse should avoid giving chloral in small quantities of water, which tend to cause irritation of the stomach and rapid absorption.

When giving hypnotics by the rectum they should be dissolved in about two ounces of boiled starch and injected into the rectum through a catheter by means of a syringe.

Administration of Coal Tar and Newer Synthetic Drugs

This group includes such substances as phenacetine, acetanilid, antipyrine, pyramidon and many of their derivatives. Salicylic acid and its newer compounds such as aspirin are given in the same manner.

These substances should be given between meals in about a wineglassful of wine or milk. Wine is perhaps preferable because the alcohol will tend to overcome the weakening action on the heart of many of these substances. The coal tar substances should be given in small quantities of fluid for slow absorption. This prevents the sudden formation of

large quantities of the substances which are responsible for their poisonous effects.

Administration of Oils

Oils are given for nourishment or as laxatives. They are broken up in the intestines into fine globules by the bile and pancreatic juice, and are then decomposed into their constituent fatty acids. These may be combined again and stored up in the body as fatty tissue. Many of the fatty acids thus formed in the intestines are substances which have a decided cathartic effect. The oils given as cathartics usually have a very unpleasant taste which must be disguised. This is usually done by giving the oil with raspberry juice, wine, soda water, lemon juice or whiskey. These fluids prevent the contact of the oil with the taste buds in the mouth and thus impart their own taste to the tongue rather than that of the oil. It is not essential that oils used as cathartics should be fresh. Old rancid oil is often better, as it has already been changed to fatty acids which are responsible for the effect.

Administration of Mineral Oil

Liquid petrolatum, mineral oil, or liquid paraffin is usually given merely to prevent absorption of water; thus increasing the bulk of the foeces, and lubricating the intestinal tract, and movements of the bowels result. These substances should be given undiluted about two hours after meals, perhaps slightly flavored with a little peppermint, raspberry juice or cinnamon water.

ADMINISTRATION BY RECTUM

Remedies are given by rectum for the following effects:

1. To move the bowels.
2. To medicate diseased condition of the rectum, sigmoid or colon.
3. For absorption, to cause general effects.

Enema: For a cathartic effect the object of injecting a fluid into the rectum is merely to distend the bowels. This starts peristalsis and causes movements of the bowels. Drugs are usually given for this effect by means of an enema. When

it is desired to inject fluid into the sigmoid or descending colon the patient should be placed in the knee elbow position.

Irrigation: To affect the mucous membrane of the rectum or descending colon or to remove gas or fluid, irrigations are used. The method consists of injecting fluid into the rectum and siphoning it back. An ordinary enema can, with a tube and tip is used. The lubricated tip is inserted into the rectum, the fluid is allowed to run in and is then siphoned back by alternately elevating and lowering the can. Every time the can is lowered below the level of the patient the fluid should return from the rectum.

An excellent method of irrigating is by means of Kemp's irrigating tube, which consists of an inflow and outflow tube in one. The inflow tube is connected with the can by means of a rubber tube. When the fluid is allowed to run into the rectum it returns through the outflow tube.

For absorption: Remedies are frequently given by rectum for absorption, in cases where it may not be possible or where it is harmful to administer them by mouth. They may be given in the form of suppositories which consist of cocoa butter impregnated with the drug. These are inserted into the rectum, the cocoa butter dissolves, is absorbed and carries the drug with it into the blood stream.

Substances are absorbed more readily from the rectum, however, when given by the **Rectoclysis** or **Murphy** method. The method is the same as an irrigation, but a return flow is not desired. The essential feature of this method is to allow the fluid to run in slowly, drop by drop, so that it is absorbed and does not distend the intestine. The drug to be administered should be dissolved in a large quantity of water (about a pint to a quart). Normal salt solution should not be used as a solvent as it is not absorbed as readily as water. Many remedies such as the salicylates are occasionally given by this method.

Although substances are not absorbed as readily from the rectum as from the small intestine, the chemical changes that may occur with the food or in the passage through the liver may thus be avoided, and the substances then enter the blood in a pure form.

METHODS FOR INTERNAL ADMINISTRATION OF COMMON REMEDIES

Based on Physico-chemical Laws

Drug	Time of Administration	Character and Quantity of Fluid	Method of Administration
Acids: Dilute hydrochloric Dilute sulphuric Dilute nitric, etc.	Before or with meals.	In tumblerful of water.	Sipped through a glass tube or straw.
Alkalies: Sodium bicarbonate Lime water Calcium salts, etc.	For effect in stomach *after meals.* For general effects *before or between meals.*	In half wineglassful of milk. In glass of water.	
Inorganic Salts: Sodium sulphate Sodium phosphate Potassium sulphate Potassium and sodium tartrate (Rochelle salt) Magnesium sulphate Carlsbad water Magnesium citrate Seidlitz powder..... Potassium bitartrate Potassium Sodium Acetate Potassium Sodium Citrate	In the morning on an empty stomach	*To lessen oedema,* in wineglassful of water. *For cathartic or diuretic effect* in glass (or more) of water.	Dissolve each *Seidlitz Powder* in ½ to ½ glass of water and mix the two together.
Iodides Nitroglycerine, nitrites, etc.	After meals	In glassful of milk, flavored with a little sarsaparilla, wine or cinnamon water.	
Metallic Salts: Mercury Iron Arsenic Salts Silver Zinc, etc. used as astringents Bismuth salts Barium	For *absorption* after meals..... For *local* effect between meals.	In glass of milk In small quantity of milk.	Iron preparations should be sipped through a glass tube or straw. For X Ray pictures, in glass of milk or as porridge.
Alkaloid Salts: Morphine Atropine Strychnine, etc. salts Quinine	After meals. As bitter, before meals. As bitter, before meals, undiluted.	In wineglassful of water slightly flavored. In wineglassful of sherry wine.	

Drug	Time of Administration	Character and Quantity of Fluid	Method of Administration
Glucosides: Digalen Strophantin Ouabain Digitalis Preparations	Between meals...	In glass of water slightly flavored.	
Galenicals: Extracts Infusions Fluidextracts Tinctures, etc. Bitters	Before meals.	Well diluted in a large glass of water. Undiluted and unflavored.	
Hypnotics: Chloral Trional Tetronal Veronal Sulphonal Paraldehyde, etc.	15 min. before bed-time. ½ to 2 hours before bed-time 2 to 3 hours before bed-time.	In glass of warm milk or in beer. Milk should be well diluted with water.	May be given per rectum in ℥ ii of boiled starch solution, injected with a glass syringe through a catheter.
Coal Tar and Synthetic Drugs: Phenacetine Acetanilid Antipyrine Pyramidon Salicylates Aspirin, etc.	Between meals...	In wineglass of wine or milk.	
Oils: Olive oil Cod liver oil Castor oil Croton oil	1 or 2 hours after meals.....	In wineglassful of brandy, wine or lemon juice "Cocktail method" or as emulsion. One or two drops dissolved in glycerine, olive oil, or butter, or on a piece of bread or sugar.	*To unconscious or insane patients:* Placed on back of tongue with a spoon.
Hydrocarbons: Liquid Petrolatum (Mineral oil) Liquid vaseline Albolene Russian mineral oil, etc.		Add just a little peppermint, raspberry juice or cinnamon water to flavor.	

ADMINISTRATION BY INHALATION

Many substances are frequently given by inhalation. The drug is usually dissolved in water which is kept constantly boiling so that steam is formed. This may be done in a specially constructed apparatus (croup kettle), or in an ordinary dish. The patient sits under an improvised tent and inhales the medicated steam.

Drugs such as stramonium are frequently given by inhalation by merely burning the leaves in a saucer or by having the patient smoke cigarettes made from such leaves.

ADMINISTRATIONS BY INUNCTIONS

Drugs are frequently given for absorption by rubbing on the skin. They are usually applied in the form of an ointment from which the drug is absorbed and produces its effects. The ointment must be rubbed over a large area of skin to get the greatest amount of absorption, and since the pores of the skin frequently get clogged up with it after constant use, a different region of the body should be used every day. Six successive daily rubbings on various parts of the body are called a "course." The course is usually given in the following order:

Each thigh, each arm, the chest, and finally the back. On the seventh day the patient should be given a bath to eliminate the drug and then the course is begun again.

When administering potent remedies by means of rubbings, the nurse should protect her hands by old kid gloves or by rubbing the ointment with a piece of chamois. Otherwise she may absorb it herself and get poisonous effects. The efficiency of the method depends largely on the vigor with which the ointment is rubbed and the extent of surface upon which the ointment is rubbed.

ADMINISTRATION BY VAPOR

Some substances, such as mercury, are frequently given by means of vapor formed by burning some of the preparations. The patient sits in a small closed cabinet over the fumes formed by burning the drug in a saucer, the head protruding from the top. The vapor generated in the cabinet is absorbed by the skin and induces the desired effects.

PART II—DRUGS USED PRINCIPALLY FOR THEIR EFFECTS ON THE STOMACH OR INTESTINES

CHAPTER VI

ACIDS AND ALKALIES

Physiology of the Stomach

The stomach changes certain kinds of food (proteins), such as eggs, meat, etc. to simpler substances of a more fluid character. They can then be more easily acted upon by the digestive juices of the intestinal tract and are thus more readily absorbed through the lining membrane of the stomach and intestines. The process whereby the food is changed to simple fluid substances which can be absorbed is called digestion.

The digestion of the food is partly brought about by means of the gastric juice, which is secreted by the lining membrane of the stomach. This juice contains two ferments: pepsin and rennin, which together with hydrochloric acid, also secreted in the stomach, change the complex food substances into simpler substances of a more fluid character.

While these changes are going on, the contractions of the involuntary muscles (peristalsis) of the stomach wall, move the food onward into the intestines, so that the stomach is completely emptied in about two hours.

The functions of the stomach then, are:

1. **Secretory,** to secrete gastric juice and digest the food.
2. **Motor,** to move the digested food onward, into the intestines for further digestion.

A drug which acts on the stomach may increase one or both of these functions, or it may replace the acid or ferments which may not be secreted in sufficient quantities.

ACIDS

Acids are very sour substances, either fluid or solid, which consist of several chemical elements combined with hydro-

gen. The hydrogen can be replaced by an alkali, thus forming a salt.

The acids are divided into two groups: **inorganic or mineral acids,** and **plant or organic acids.**

The vegetable or organic acids contain carbon as one of the elements, while the inorganic or mineral acids do not contain carbon.

Most of the acids are very poisonous substances unless they are given in very dilute solutions.

INORGANIC OR MINERAL ACIDS

The mineral acids principally used in medicine are hydrochloric, sulphuric, nitric, nitrohydrochloric, and phosphoric acids. They are used principally to replace acid in the stomach when its secretion is diminished. The organic acids produce practically the same effects as the inorganic acids with only slight individual differences.

ACTION

Local action: Applied to the skin, or mucous membranes, concentrated solutions of acids are very injurious to the tissues, and destroy the skin, mucous membranes and underlying tissues.

The tissues become shrunken, hard and brittle, because the acids withdraw water from the tissues with which they come in contact.

Dilute solutions of the acids usually **contract mucous membranes.**

Internal Action

In the mouth: The dilute solutions ordinarily used have a characteristic sour taste and relieve thirst. They increase the flow of saliva and contract the mucous membrane of the mouth.

In the stomach: The acids aid the digestion of protein or albuminous food, since the pepsin acts only in the presence of an acid, particularly hydrochloric acid.

In the intestines: If the acid enters the intestines, it is immediately neutralized by the alkaline juices which are always present there. Salts are thus formed, and at the same time the pylorus of the stomach immediately closes, to prevent more acid from entering the intestines. In a reflex manner by forming **secretin** (a ferment which enters the blood stream and affects the pancreas), from the cells of the pylorus of the stomach the acids increase the secretions of the pancreatic juice.

Action after Absorption

The acids are rapidly absorbed into the blood from the stomach, in combination with proteins or as salts formed with the alkalies of the tissues. They then produce no effects, except to make the blood somewhat less alkaline in reaction. The organic acids, however, are changed to carbonates which then act as alkalies. As a rule, the alkalinity of the blood is not greatly influenced by acids.

Excretion

The acids are eliminated from the body by the urine, as acid salts; the alkalies of the salts being kept back in the blood. The urine is therefore more acid in character, and often slightly injures the kidneys, when the urine may contain albumin or blood. The patient may also have burning pain in the bladder when passing urine.

Poisonous Effects

Acute acid poisoning usually results from an acid taken with suicidal intent. The poisonous effects of all the acids are the same; except that hydrochloric and nitric acids make the tissues yellow and hard, while sulphuric acid turns the tissues white in color and then brown.

Symptoms

1. Severe burning pain in the mouth, throat and stomach. The tissues about the mouth become dry, shrunken, white or yellow in color.

2. **Profuse vomiting.** The vomited matter contains blood and pieces of mucous membrane.

3. **Profuse diarrhoea,** the stools containing blood and pieces of mucous membrane.

As a result of the destruction of the mucous membrane of the stomach and intestines, the patient suffers from:

4. **Profound collapse** (rapid, thready, weak pulse, slow, shallow breathing, subnormal temperature). Death usually occurs in several hours.

Frequently, as a result of lessened alkaline salts in the blood, there occurs:

5. Difficult breathing.

6. Twitchings of the muscles or convulsions.

Occasionally the fumes of the acid may cause swelling of the larynx (oedema of the glottis), and the patient may then die of asphyxia.

If the patient recovers, he may suffer from various symptoms produced by the narrowing (stenosis) of the oesophagus, because of the scar tissue formed by the healing of the wound.

Treatment

1. Neutralize the acid with an alkali; such as **magnesia, or magnesium carbonate, sodium bicarbonate, or lime water.**

Sodium bicarbonate should be used cautiously as it may form carbon dioxide gas and distend the stomach.

If these substances cannot be obtained, chalk, plaster from the wall, soap suds, etc., may be used. Giving plenty of water helps to dilute the acid. The stomach may be washed out, but with great care, as the stomach tube may pass through the injured stomach wall.

2. Protect the mucous membranes of the oesophagus and stomach by white of egg, milk, flour and water, etc.

3. Keep the patient quiet.

4. The collapse is treated with heart stimulants, such as caffeine, strychnine, atropine, etc.

5. Sodium bicarbonate solutions are given intravenously or per rectum, to increase the alkaline salts in the blood.

Administration

All the acids should be given before or with meals, well diluted, sipped very slowly through a glass tube, so as not to injure the teeth. Diarrhoea and griping pains in the abdomen are symptoms of excessive action.

PREPARATIONS OF THE MINERAL ACIDS

DILUTE HYDROCHLORIC ACID

Dilute hydrochloric acid is used principally to aid digestion in cases where there is an insufficient amount of hydrochloric acid secreted in the stomach; and the pepsin is then unable to digest the food. This often occurs in such diseases as chronic gastritis, or in infectious diseases.

It is also used to lessen thirst, especially in fevers, and to check intestinal putrefaction and diarrhoea.

Preparations

Dilute Hydrochloric Acid (Acidum Hydrochloricum Dilutum)	0.3–2.0 c.c	m. v–xxx

It contains 10% of hydrochloric acid.

For Local Use

Hydrochloric Acid (Acidum Hydrochloricum)

This contains 31% of hydrochloric acid.

Oxyntin (not official)	0.3–1.0 gm.	grs. v–xv

This is a compound of protein and hydrochloric acid and is used as a substitute for the latter substance for the digestion of proteins. It is only half as strong as dilute hydrochloric acid.

SULPHURIC ACID (OIL OF VITRIOL)

Sulphuric acid acts like the other acids, except that it checks intestinal secretions and the sweat.

It is rarely used except as a remedy for lead poisoning and occasionally to check diarrhoea and night sweats. The

concentrated acid is occasionally used to destroy an infected area of the skin (caustic action).

Preparations

Dilute Sulphuric Acid 0.6–2.0 c.c. m. x–xxx
(Acidum Sulphuricum Dilutum)

This contains 10% of sulphuric acid.

Aromatic Sulphuric Acid 0.3–1.0 c.c. m. v–xv
(Acidum Sulphuricum Aromaticum)

This contains 20% of sulphuric acid in alcohol, flavored with ginger and cinnamon.

For Local Use

Sulphuric Acid
(Acidum Sulphuricum)
(Oil of Vitriol)

This contains 92% of sulphuric acid.

NITRIC ACID (AQUA FORTIS)

Nitric acid acts like other acids, except that it is said to increase intestinal secretions and the secretion of bile. It is occasionally used instead of hydrochloric acid to aid digestion. A drop of the strong acid is frequently applied on the skin to destroy an infected area.

Dilute Nitric Acid 0.6–2.0 c.c. m. x–xxx
(Acidum Nitricum Dilutum)

This contains 10% of nitric acid.

For Local Use:
Nitric Acid
(Acidum Nitricum)

This contains 68% of nitric acid.

NITROHYDROCHLORIC ACID

Nitrohydrochloric acid or aqua regia, is a mixture of one part of nitric and 4 parts of hydrochloric acid. It is the

most powerful acid, and the only fluid which will dissolve platinum and gold.

This acid diluted, is principally used to increase the flow of bile, given in the following ways:

1. By mouth, sipped through a glass tube.
2. In a foot bath or ordinary bath.
3. It is said to be more efficient if it is applied to the liver in the form of a stupe, about 4.0–8.0 c.c. or 3i–ii of the dilute acid being used to a pint of water.

Preparations

Dilute Nitrohydrochloric Acid (**Acidum Nitrohydrochloricum Dilutum**) 0.3–1.0 c.c. m. v–xv

This contains 40 parts of nitric acid and 180 parts of hydrochloric acid in 1000 c.c. of water.

Dilute phosphoric acid is principally used as a tonic. It does not destroy tissues like the other mineral acids.

PLANT OR ORGANIC ACIDS

The plant or organic acids are obtained from various fruit juices such as the grapes, lemons, or by the prolonged fermentation of wines.

Their effects are similar to those produced by the mineral acids, but they are milder, and they act as alkalies after absorption. They do not produce poisonous effects, except when given in very large doses.

The organic acids commonly used are acetic, citric and tartaric acids.

The acetic acid is the most active one in the group; the others have a milder action.

DILUTE ACETIC ACID

Acetic acid is an organic acid formed by the prolonged fermentation of various fruits and vegetables. Thus, when wine is fermented for a long time, vinegar is formed, which consists mostly of acetic acid.

ACTION

Local action: Dilute acetic acid hardens and cools the skin;

it contracts the mucous membranes. It checks bleeding by contracting the blood vessels.

Concentrated solutions however, when locally applied, cause redness, pain, and the formation of a blister with slight destruction of the skin.

Internal Action

In the mouth: Dilute acetic acid has a very sour taste, it increases the flow of saliva, thereby lessening thirst.

In the stomach: It increases the secretion of gastric juice, it improves the appetite, and aids digestion.

In the intestines: It increases the secretions, but it is readily neutralized by the alkaline intestinal juices.

Action after Absorption

Acetic acid is rapidly absorbed from the stomach. It is oxidized in the blood to carbonic acid. It then forms carbonates by combining with the alkaline salts in the blood. The carbonates thus formed are excreted by the urine, the quantity of which is very much increased.

Poisonous Effects

The symptoms of poisoning by large doses of acetic acid, are similar to those caused by the mineral acids, but they are rarely fatal. The treatment is the same.

Chronic Poisoning

Continued use of acetic acid often causes emaciation, loss of weight, and anaemia.

Preparations

Vinegar (not official)
Acetum

Vinegar is obtained by prolonged fermentation of alcoholic liquors. The best vinegar is made from cider, and consists mostly of acetic acid.

Dilute Acetic Acid (**Acidum Aceticum Dilutum**)	2.0–8.0 c.c.	$3\frac{1}{2}$–ii

This is a pure form of vinegar which contains 6% of acetic acid.

These preparations are used principally to harden the skin, to check bleeding; and by inhalation, to relieve fainting (reflexly strengthening the heart action in this way). They are also used to neutralize poisoning from alkalies.

For Local Use

Glacial Acetic Acid
(Acidum Aceticum Glaciale)

This contains 99% of acetic acid.

Trichloracetic Acid
(Acidum Trichloraceticum)

This is a crystalline substance.

These two latter preparations are used principally to remove warts and to cauterize or destroy tissues.

CITRIC ACID

Citric acid is an organic acid which is found in the juice of the lemon, or **Citrus limonum,** and the lime, **Citrus bergamia.**

ACTION

Citric acid acts like acetic acid.

1. It increases the flow of saliva and relieves thirst.
2. It increases the appetite and the flow of gastric juice, thereby aiding digestion.
3. It slightly increases the movements of the bowels. Thus, the juice of half a lemon, if given before breakfast is a good laxative.
4. It increases the sweat, especially if given hot, as in a hot lemonade.
5. It increases the flow of urine, in which it is excreted as an alkaline carbonate, thereby lessening the acidity of the urine.
6. Citric acid is frequently given on shipboard as an article of diet, to prevent scurvy, a severe disease of the joints due to the lack of vegetable food in the diet.

Citric acid is not a poisonous substance, but its continued use occasionally causes anaemia and loss of weight.

Preparations

Citric Acid
(Acidum Citricum)

This is occasionally used in doses of 30.0 gms. (℥i), to a pint of water; instead of lemonade.

The best way to administer citric acid is in the form of lemonade. To produce sweating it is best given hot.

TARTARIC ACID

Tartaric acid is the acid of grape juice. Its action is similar to that of acetic acid.

It is principally used to increase the flow of urine, in which it is excreted as alkaline carbonates.

It is also used as a laxative, and it is an ingredient of the seidlitz powder.

Tartaric acid is usually given in the form of grape juice, as a cooling refreshing drink. As a diuretic or laxative, its various salts such as potassium tartarate, etc., are preferred.

LACTIC ACID

Lactic acid is a thick, syrupy liquid formed in milk when it turns sour as a result of bacterial fermentation. It is also formed by the fermentation of milk sugar or grape sugar.

ACTION

When taken internally, it acts like the other organic acids:

1. It increases the appetite and aids digestion.
2. It is said to increase nutrition.
3. It enters the blood as lactates and is excreted by the urine as alkaline carbonates.

It is principally used, however, as a local application to heal tuberculous ulcers of the pharynx or larynx, and to remove diphtheritic membranes. The applications are very painful.

Lactic acid is formed by the fermentation of bacteria in milk and is therefore contained in many fermented milks, such as Kumyss, Zoolak, Fermilac, etc.

Preparations

Lactic Acid (Acidum Lacticum)	0.3–2.0 c.c.	m. v–xxx

This contains 75% of pure lactic acid.

OXALIC ACID

Oxalic acid is an organic acid, found in **sorrel** and other vegetable substances. It is never used as a medicine, but **potassium oxalate**, or **essential salt of lemon**, and oxalic acid are frequently used to clean metal kitchen utensils. These salts resemble epsom salts in appearance, and are a frequent cause of severe poisoning, when taken by mistake, or with suicidal intent. The symptoms are due to the removal of calcium from the blood and tissues, because the oxalic acid readily combines with it.

Oxalic Acid Poisoning

The symptoms usually appear in a few minutes:

1. Severe burning pain in the mouth or throat.
2. Intense cramp-like abdominal pain.
3. Profuse vomiting, the vomited matter containing mucus, pieces of mucous membrane and blood.
4. Muscular weakness and twitchings of the muscles.
5. Occasionally convulsions.
6. Collapse (rapid, irregular, weak, thready pulse, slow shallow breathing, cyanosis, cold moist skin, coma and death).

The patient may die in a few minutes from collapse; or in a few weeks from starvation or from nephritis, as a result of the injury to the stomach, intestines and kidneys. 30.0 gms. or ʒi of oxalic acid usually prove fatal; though death has occurred from as little as 4.0 gms. (ʒi).

Treatment

1. Neutralize the oxalic acid at once with an alkali, such as calcium. Lime water, chalk or the plaster from the wall may be used for this purpose.

Do not give any preparation of sodium or potassium, as these form poisonous substances with the oxalic acid.

2. Give emetics.

3. Protect the mucous membranes with egg albumin, milk, etc.

4. The collapse is treated with heart stimulants, such as strychnine, caffeine, digitalis, etc.

Other organic acids occasionally used are:

Hydrocyanic Acid
Tannic Acid
Gallic Acid

These are considered under their more important actions for which they are principally used.

ALKALIES AND ALKALINE EARTHS

The following drugs are used principally to neutralize acids and are therefore often called **antacids.**

An alkali is a substance which belongs to a group of chemical substances called bases. Alkalies combine with acids to form salts. They dissolve proteins, forming protein combinations which act like salts. They also combine with fats to form soaps.

The substances commonly used as alkalies are the salts of the following elements:

Sodium
Potassium
Ammonium

The alkaline earths are the following elements and their salts:

Calcium
Magnesium
Lithium

ACTION

Local action: Weak solutions of alkalies make the skin feel soft and soapy, by dissolving the superficial epidermis, or horny layer of the skin. Concentrated solutions destroy the skin and underlying tissues, forming a soft crust, which soon falls off, leaving an ulcer. Mucous membranes are affected in the same way as the skin. Alkalies and their salts readily dissolve mucus.

Internal Action

Sodium Bicarbonate is the preparation commonly given internally.

In the mouth: The alkalies have a characteristic alkaline taste.

They dissolve the mucous secretions, redden and soften the lining membrane of the mouth and tongue and make the mouth feel soapy.

In the stomach: They neutralize and lessen the formation of the acid in the stomach by combining with the acid to form salts.

In the intestines: The alkalies enter the intestines as salts which have been formed in the stomach. They withdraw fluid into the intestines from the blood and tissues, which then distends the intestines and causes frequent movements of the bowels. They also dissolve the mucus in the intestine.

Action after Absorption

Some of the salts of various alkalies or those formed in the stomach are readily absorbed into the blood. These salts make the blood more alkaline in reaction, and thereby relieve various conditions due to diminished alkaline salts in the blood (acidosis). They have no selective action on any of the organs of the body.

Excretion

The alkalies and their salts are excreted mainly by the kidneys, increasing the flow of urine at the same time. They lessen the acidity of the urine or make it alkaline in reaction. They are also slightly excreted by the mucous membranes.

Poisonous Effects of Alkalies

Acute poisoning frequently results from some of the alkalies when they are taken by mistake. Washing soda, lye, or sodium carbonate is commonly used for cleaning purposes. It is found in every household, and if carelessly left around the house, it is occasionally taken by children, producing very serious symptoms.

Symptoms

The symptoms usually appear in a few minutes after the alkali has been taken:

1. **The tissues about the lips and mouth are destroyed** and covered with a swollen white crust, and there are pieces of bloody moist shreds of tissue around the lips and mouth.
2. **Severe abdominal pains.**
3. **Profuse vomiting.** The vomited matter contains pieces of mucous membrane and blood.

4. Occasionally there is diarrhoea, the stools containing blood and pieces of mucous membrane.

5. Collapse (rapid thready pulse, slow shallow breathing, cold moist skin, and dilated pupils).

The patient may die of collapse, or occasionally from a perforation of the stomach wall, resulting from the destructive action of the alkali.

If the patient recovers from the acute symptoms, the scars which form at the areas in the oesophagus and stomach where the tissue was destroyed, make these organs narrower (stenosis). This condition may necessitate radical surgical treatment.

Treatment

1. Give as an antidote, a dilute vegetable acid such as lemon juice, vinegar or dilute acetic acid.

2. Protect the mucous membrane by egg albumin, oils or milk.

3. The collapse is treated with heart stimulants; such as caffeine, strychnine, atropine, digitalis, etc., and the patient should be kept warm.

Do not wash out the stomach, since passing a stomach tube may cause a perforation of the stomach.

Uses of the Alkalies

The alkalies are principally used for the following conditions:

1. To neutralize the acid in the stomach, in **hyperacidity,** a condition where there is too much acid secreted in the stomach. It is also given in **ulcer of the stomach.** In this condition pain is due to the excessive amount of acid formed in the stomach, which is neutralized by the alkalies. In these cases the alkalies are best given about a half to one hour after meals, when the stomach contains the largest amount of acid.

2. They are also used to dissolve mucus and other secretions.

3. To increase the alkaline salts in the blood in cases of diabetic coma and other similar conditions due to excessive formation of acids in the body (acidosis).

Administration

To neutralize acids, alkalies should be given after meals, only slightly diluted to lessen absorption.

To increase the alkaline reaction of the blood they should be given between meals in large quantities of water to increase absorption.

In cases of coma they may be given intravenously or by rectum in the form of a Rectoclysis.

PREPARATIONS OF THE ALKALIES

SODIUM COMPOUNDS

Sodium is a metallic element. It is found in nature in various forms:

1. As sodium chloride or salt, in salt mines, or obtained from sea water by evaporation.
2. In Chili it is found as sodium nitrate.
3. As borax or sodium borate in various parts of the world.

Preparations

Sodium Hydroxide
(Sodii Hydroxidum)
(Caustic Soda)

This comes in white sticks, which readily take up moisture from the air. It is occasionally applied as a caustic, to destroy tissue. It often causes severe injury to the tissues.

Solution of Sodium Hydroxide 1.0–4.0 c.c. m. xv–℥i
(Liquor Sodii Hydroxidi)

This is a 5% solution of sodium hydroxide in water.

Monohydrated Sodium Carbonate 0.3–2.0 gms. grs. v–xxx
(Sodii Carbonas Monohydratus)

Sodium Carbonate 0.3–2.0 gms. grs. v–xxx
(Sodii Carbonas)
(Washing Soda)

These two preparations are rarely used internally. Externally they are used to dissolve mucus and other secretions. They are frequently used to clean glass, china, woodwork, etc. They frequently cause poisonous symptoms when taken by mistake.

SODIUM BICARBONATE

Sodium bicarbonate is the most commonly used alkali. When applied locally in solutions it dissolves crusts and secretions resulting from inflammations. Applied to mucus membranes it dissolves mucous and inflammatory secretions.

Internally, it neutralizes the hydrochloric acid in the stomach by combining chemically with it forming sodium chloride. It also checks fermentation, neutralizes the organic acids formed in the stomach by fermentation, and dissolves mucous. By neutralizing the excessive acid in the stomach it lessens spasm at the pylorus of the stomach.

Sodium bicarbonate is absorbed into the blood stream as sodium chloride. Consequently it increases the sodium ions in the blood and it thus increases the alkalinity of the blood.

Uses

Locally, solutions of sodium bicarbonate are applied to burns, eczema, and other skin diseases, as a soothing application to dissolve crusts and secretions. It forms an important ingredient of most mouth washes, gargles and tooth pastes, because of its ability to dissolve mucus.

Internally it is used principally in conditions of hyperacidity and ulcer of the stomach, for the purpose of neutralizing the excess of acid. It therefore lessens the pain produced by the spasm at the pylorus, which results from the excess of acid. It is also given to check nausea and vomiting and fermentation in the stomach even when no excess of hydrochloric acid is evident.

Sodium bicarbonate is extensively used for the treatment of the condition known as Acidosis. This is a group of symptoms due to the fact that the alkaline reaction of the blood is diminished by the presence in the blood of various acids such as acetone, diacetic acid and oxybutyric acid, which are formed from the tissues. When these acids are present in the blood in excess they also appear in the urine and can be recognized on the examination of the urine. A normal alkaline reaction of the blood is essential to life and

when the alkalinity is diminished the symptoms of acidosis occur. Acidosis occurs in diabetes, delayed chloroform poisoning, uremia and starvation. The symptoms occur gradually and consist principally of headache, vomiting, a peculiar type of breathing, and finally coma and death.

Acidosis is treated by giving the patient large doses of sodium bicarbonate so as to increase the alkaline condition of the blood by neutralizing the excess of acid substances in the blood.

Administration

Locally sodium bicarbonate is applied in solutions of various strengths usually combined with other remedies. In stomach cases when it is given for excessive acid, it should be given in vichy, seltzer or warm water. Frequently it is given in capsules or powders combined with other alkalies such as bismuth or magnesia. For gaseous distention (flatulence) it should be given before or between meals in a tumblerful of vichy, seltzer or warm water.

In acidosis sodium bicarbonate is given by mouth, by rectum or intravenously. In mild cases it is given by mouth in doses of 0.6–1.0 gm. (grs. x-xv) three times a day. In the severe cases about 4.0 gms. (3i) is given three times a day, or by rectum in 3–5% solutions by the Murphy or Rectoclysis method. In the very severe cases the sodium bicarbonate is given intravenously in 3–5% solutions about 500 c. c. at a time. Sodium Bicarbonate produces effects in acidosis only if it is given in very large doses.

Sodium Bicarbonate (Sodii Bicarbonas)	0.3–2.0 gms.	grs. v–xx

Troches of Sodium Bicarbonate (Troschisci Sodii Bicarbonatis)

There are numerous other preparations which contain sodium bicarbonate, such as seidlitz powder; but these are used principally as cathartics.

POTASSIUM COMPOUNDS

The salts of potassium act like the sodium compounds with the following variations in their effects:

1. Concentrated solutions, such as potassium hydroxide, have a greater destructive action on the skin. They destroy the skin and underlying tissues, causing an ulcer when the resulting crust falls off.

2. The salts of potassium when absorbed into the blood, slightly weaken and slow the contractions of the heart.

3. They increase the flow of urine more than the sodium compounds.

The potassium salts are very rarely used as alkalies.

Preparations

Potassium Hydroxide
(Potassi Hydroxidum)
(Caustic Potash)

This comes in white sticks which take up moisture from the air. It is used principally as a caustic, to destroy tissues. When this is applied locally, the surrounding tissues about the spot to be cauterized, should be well protected owing to its violent action.

Solution of Potassium Hydroxide (**Liquor Potassii Hydroxidi**)	0.6–2.0 c.c.	m. x–xxx

This contains 5% of potassium hydroxide.

Potassium Carbonate (**Potassii Carbonas**)	0.3–2.0 gms.	grs. v–xxx

Potassium Bicarbonate (**Potassii Bicarbonas**) (saleratus)	0.3–2.0 gms.	grs. v–xxx

Potash and Lime
(**Potassa cum Calce**)

This is known as Vienna paste, and consists of equal parts of potash and quicklime and is used locally as a caustic.

Various salts of **ammonium** are used as alkalies or antacids. Their action has been described under their other more important effects.

ALKALINE EARTHS

The most common alkaline earths used in medicine are the salts of calcium and magnesium. These salts differ from the alkalies in being very insoluble. They are therefore not readily absorbed, and produce only a local effect in the stomach and intestines.

CALX OR CALCIUM (LIME)

Calcium salts are found very abundantly in nature. They are found in large quantities in all the tissues of animals. Calcium phosphate is found in the bones and teeth of all animals, as well as in many of the soft tissues. Calcium salts are necessary for the activity of many forms of living matter.

Many mineral substances contain large quantities of calcium salts. Thus, **calcium carbonate** is found in chalk, marble and limestone. **Calcium sulphate** is found in plaster of paris, gypsum and alabaster.

Calcium preparations are used to clean teeth, and form, therefore, an ingredient of most tooth powders or pastes.

ACTION

Local action: The calcium salts have no effect on the skin. Calx or unslaked lime however, burns and destroys tissues if applied to mucous membranes.

Internal Action

In the mouth: The calcium salts contract the mucous membranes.

In the stomach: They neutralize the acid, lessen digestion and contract and soothe the mucous membranes.

In the intestines: They contract and soothe the mucous membrane (astringent action).

Action after Absorption

The calcium salts are very slowly absorbed from the stomach and intestines. Part of these salts are absorbed into the blood, however, and help to form fibrin ferment, so that the blood clots better.

In diseases where there is an insufficient amount of calcium or lime in the body, such as rickets, the bones become softened and are often deformed. The calcium absorbed from the blood is then deposited in the bones and hardens them.

Calcium is also necessary for the nutrition of nerve tissues. Many nervous conditions characterized by twitching of the muscles are believed to be due to a deficiency of calcium in the body.

Excretion

The calcium salts are excreted mostly by the large intestine and kidneys.

Poisonous Effects

Poisoning from lime occasionally occurs when unslaked lime is swallowed. The symptoms are the same as those of poisoning by other alkalies.

Slaked lime occasionally causes severe destruction of the

tissues. Laborers who handle lime, occasionally get some of it into the eye. Severe destruction of the eye, even loss of sight, may then result. When this happens the eye should immediately be thoroughly washed out with a solution of boric acid.

Uses

Solutions of calcium are used locally to soothe the skin in burns. **Internally,** calcium is used to neutralize the acid in the stomach, in **hyperacidity,** to lessen nausea and vomiting, and in **ulcer of the stomach.**

When given to neutralize the acid, it is best given about a half to one hour after meals, when the stomach contains the largest amount of acid. Calcium preparations are also used as antidotes for poisoning by acids.

Calcium salts are frequently given in nervous conditions characterized by excitability, such as epilepsy, tetany, etc.

Preparations

For Internal Use

Lime Water 30.0–120.0 c.c. ʒi–iv
Solution of Calcium Hydrate
(Liquor Calcis)

This is a saturated solution of calcium hydrate or slaked lime, containing 0.17 gm. of calcium hydrate to 100.0 c.c. of water, or gr. ½–¾ to ʒi of water.

It is made by washing slaked lime with distilled water, and then filtering the resulting solution.

It is used to neutralize the acid in the stomach, to soothe the stomach and to lessen nausea and vomiting. It is very constipating.

When added to milk, it lessens curdling in the stomach and makes the milk more digestible.

Syrup of Lime 1.0–4.0 c.c. m. xv–ʒi
Syrup of Calcium Hydroxide
(Syrupus Calcis)

This contains 5% of lime.

Calcium Chloride 0.3–1.0 gm. grs. v–xv
(Calcii Chloridum) (well diluted)

This is used to increase the clotting of the blood. It is somewhat injurious to the tissues however. When fresh it is a good antiseptic, ʒvi of the calcium chloride being used to a gallon of water.

Calcium Lactate (not official) 0.2–0.6 gm. grs. iii–x
(Calcii Lactas)

This is used principally to increase the clotting of the blood in haemorrhage. It is frequently given for several days before tonsil and adenoid operations to prevent profuse bleeding. It is occasionally given hypodermically.

For Local Use

Lime Liniment
(Linimentum Calcis)
Carron Oil

This is a mixture of lime water and olive or linseed oil in equal parts.

Unslaked Lime
Calx

This is made from limestone. It forms a white mass which cracks and changes to a powder, when placed in water, forming **slaked lime** and liberating heat.

It is used as a disinfectant and to destroy tissue (caustic).

For this purpose it is used together with potassium in the form of vienna paste or potassa cum calce.

Milk and Lime (non-official)
Whitewash

This is made by adding 1 part of slaked lime to 4 parts of water. It is used as a disinfectant, especially for typhoid and cholera stools. It is also a soothing application for burns.

Chalk Mixture (Mistura Cretae)	15.0–30.0 c.c.	℥ss–i

This contains 20 gms. chalk suspended in 100 c.c. of water.

MAGNESIA

The preparations of magnesia act similarly to those of calcium.

1. They neutralize the acid in the stomach.
2. They are not readily absorbed, passing into the intestines, where they act as cathartics, causing frequent fluid stools.
3. The small amount of magnesia that is absorbed, increases the alkaline reaction of the blood. It is excreted by the urine, which it increases in amount, lessens its acidity or makes it alkaline in reaction.

Preparations

The preparations of magnesia, which are principally used to neutralize the acid in the stomach, are:

Magnesium Oxide (Magnesii Oxidum) (Calcined or light magnesia) (The Magnesia Usta of the German Pharmacopoeia)	0.3–4.0 gms.	grs. v–℥i
Milk of Magnesia	4.0–16.0 c. c.	℥i–℥ss

This is a proprietary preparation containing magnesium hydrate. It is used as an antacid and cathartic.

The other preparations of magnesia are principally used as cathartics, under which group they are described.

LITHIUM

The salts of lithium are also alkaline in reaction and neutralize the acid in the stomach. They are principally used as diuretics and are described in that group.

CHAPTER VII

DIGESTANTS

In cases where the stomach secretes very little gastric juice, or where the secretion of other digestive juices is diminished, the patient is unable to digest food.

In such cases the digestion of the food can be assisted by giving various ferments which digest the food substances: proteins, carbohydrates and fats. These ferments replace the gastric or intestinal juices which may be very much diminished or absent.

Substances Used for Digestion of Carbohydrates

Carbohydrates are starchy foods, such as bread, potatoes, and sugars.

The starchy foods are partially digested in the mouth. They are changed to sugars by the saliva, which contains a ferment, **ptyalin.** The digestion of the starchy foods and sugars is completed in the intestines, by the pancreatic juice, which contains the starch digesting ferment, **amylopsin,** and by the intestinal juice which contains invertin. This ferment completes the digestion of the sugars.

Malt

Malt is barley grain which has been made to grow artificially. The growth is then stopped by means of heat.

During this growth the starch contained in the barley, is changed to sugar by means of diastase, a ferment which is contained in the barley grain.

Malt which contains this ferment, diastase, is often given to help the digestion of starch. Many of the preparations used, contain no diastase and produce no digestive effects; though they are easily digested foods. Many of the malt extracts contain alcohol, and are therefore similar to beer or stout.

Preparations

Extract of Malt (**Extractum Malti**)	16.0 gms.	ʒiv

This is an extract of malt in syrup.

Unofficial Preparations

Maltine
Maltzyme and others

Taka Diatase

This is a starch digesting ferment formed by the action of a mould (Eurotium oryzae) upon wheat bran. It is named after its discoverer, Takamine, a Japanese.

Taka diastase is very powerful and efficient, but it only acts in the stomach before the normal amount of acid is secreted. The action of starch digesting ferments is usually destroyed by the acid in the stomach.

Substances Used for the Digestion of Proteins

Proteins are food substances such as meat and eggs. Milk also contains a large percentage of proteins.

The proteins are partially digested by the gastric juice, which consists mainly of pepsin and hydrochloric acid. Pepsin can act only in the presence of an acid. Proteins are completely digested by the pancreatic and intestinal juices. The pancreatic juice contains **trypsin,** a ferment which digests proteins completely; **amylopsin,** a ferment which digests starches completely; and **steapsin,** a ferment which breaks up the fats into very small globules (emulsifies).

Pancreatic juice can act only in the presence of an alkali, but is destroyed by an acid, such as the acid in the stomach.

The intestinal juice contains **erepsin,** a ferment which completes the digestion of the proteins.

PEPSIN

Pepsin is a ferment obtained from the lining membrane of fresh stomachs of healthy pigs. It is used to aid di-

gestion in cases where the pepsin of the gastric juice is diminished.

Pepsin acts only in the presence of an acid; it should therefore always be given with dilute hydrochloric acid. Alkalies destroy its activity; it should therefore never be given with such substances as sodium bicarbonate.

Preparations

Pepsin (Pepsinum)	0.3–0.6 gm.	grs. v–x

The following unofficial preparations are often used:

Essence of Pepsin (Essentia Pepsini)	8.0 c.c.	ʒii
Glycerite of Pepsin (Glyceritum Pepsinae)	3.0 c.c.	m. xlv

The elixir of pepsin and pepsin solution are other preparations.

New and Non-official Preparations

Elixir of Enzymes	4.0–8.0	ʒi–ii

This is a solution containing pepsin and rennet in 20% of alcohol.

Rennet

Rennet is a ferment secreted by the mucous membrane of the stomach. It curdles milk.

Pegnin
Milk Sugar Rennet

About 8.0–10.0 gms. (ʒii–iiss) of pegnin are added to 1000 c.c. of cool boiled milk. The mixture is then allowed to stand for two or three minutes, and is then shaken so as to divide the clot into fine particles, and give it a uniform consistency.

PANCREATIN

Pancreatin is a mixture of all the ferments obtained from the fresh pancreatic glands of the pig. It is used principally to predigest foods, before they are given to the patient, in cases where the patient himself is unable to digest food.

Pancreatin can act only in the presence of an alkali, and must always be given with sodium bicarbonate. It is seldom given internally, as it is destroyed by the hydrochloric acid in the stomach.

When it is given internally, it should be given in pills coated with keratin, a substance which the acid of the gastric juice does not affect, but which is dissolved by the alkaline intestinal juices.

Preparations

Pancreatin (Pancreatinum)	0.1–0.3 gm.	grs. ii–v

Unofficial Preparations

Peptonizing Powder (Pulvis Pancreaticus Compositus)

This is used to predigest foods such as milk and eggs.

Each powder consists of 5 grains of pancreatic extract, and 15 grains of sodium bicarbonate.

METHOD OF PEPTONIZING MILK

Partially Peptonized Milk:

To a bottle containing one pint of milk and 4 ounces of water, add one peptonizing powder. Keep the bottle at a temperature of 105 to 115° (Fahrenheit). This is best done by placing the bottle in hot water of that temperature, for about 20 minutes to a half hour. The milk should then have a slightly bitter taste. Part of the proteins of the milk are digested by this method.

Completely Peptonized Milk:

The method for complete peptonization is the same as for partial peptonization, but it is continued for two hours, during which time all the proteins are completely digested. Completely peptonized milk has an extremely bitter taste.

Diazyme Essence	4.0–8.0 c.c.	ʒi–ii

This is a liquid containing all the amylopsin of the pan-

creas. It is used to digest starchy foods, when these are not readily digested by the saliva or pancreatic juice.

Diazyme Glycerole 4.0–8.0 c.c. ʒi–ii

This acts like the diazyme essence.

Glycerole Trypsin: By mouth 4.0–8.0 c.c. ʒi–ii

Hypodermically 0.3 c. c. (m. v.) every other day.

This preparation is given by mouth, or hypodermically for the treatment of cancer. It is supposed to digest the cancer cells.

Holadin: One capsule, three hours after meals. Each capsule
(Extractum Pancreaticum Integrum) contains 0.2 gm. grs. iii

This is an extract of the pancreatic glands which contains all the enzymes: trypsin, amylopsin and steapsin; and a milk curdling ferment. It is used in diseases where the food is not well digested.

Panase 0.12–0.3 gm. grs. ii–v

This is a combination of the digestive ferments of the pancreas, derived from the pancreatic gland of the pig. It is used where digestion is poor.

Pankreon 0.25–1.0 gm. grs. iv–xv
Tannin Pancreatin Compound 0.06–0.25 gm. grs. i–iv for children

This is a mixture containing the trypsin, amylopsin and steapsin of the pancreatic juice, and about 8% of tannin.

It acts in the intestines, aiding digestion in diseases where the food is not thoroughly digested, because of lessened secretion of the pancreas. It is also used in diarrhoea, dysentery, marasmus, etc.

Trypsin 0.12–0.3 gm. grs. ii–v

This is the protein digesting ferment of the pancreas.

It is applied in solutions containing sodium bicarbonate, to diphtheritic, or other membranes. It is also given hypodermically, in cases of cancer, to digest the cancer cells.

Ingluvin (Not official) 0.3–1.0 gm. grs. v–xv

Ingluvin is the extract of a fowl's gizzard, and is occasionally used to aid in the digestion of proteins.

Papain

Papain is the fruit of the **Carica papaya,** a tree growing in tropical countries. The juice of this fruit contains a ferment, **papain, papayotin** or **papoid** which is used to aid the digestion of proteins.

CHAPTER VIII

BITTERS, CARMINATIVES AND EMETICS

(Gastric Stimulants)

BITTERS

Bitters are vegetable drugs which increase the activity of the secretory function of the stomach, but produce no effects after absorption.

There are two kinds of bitters: **Simple and Aromatic.**

Simple bitters are vegetable substances which increase the activity of the stomach, and improve the appetite.

Aromatic bitters are vegetable substances used as bitters, which have a pleasant odor because of volatile oils which they contain.

There are other drugs which cause important effects after absorption, but which may also act as bitters in the stomach; for example, nux vomica and quinine. Many substances used as condiments with food, produce the same effect.

Action

Simple bitters have no local action on the skin.

When taken internally, they increase the appetite, and the secretion of gastric juice. The patient therefore eats more, and digests his food better. If they are taken for a long time, he gains in weight, feels better, and is generally more robust, healthier and stronger.

Poisonous Effects

Occasionally, some of the bitters, such as quassia and berberis, if given in large quantities, may cause **diarrhoea, frequent urination, nausea, vomiting, restlessness,** and a **rapid**

weak pulse. These symptoms are due to the alkaloids quassin and berberine which they contain.

Administration

Bitters should always be given before meals in fluid form. They should be given undiluted and their taste should not be disguised as this may interfere with their effect.

SIMPLE BITTERS AND THEIR PREPARATIONS

GENTIAN: The root of the Gentiana lutea, or the yellow gentian of the Alps.

Extract of Gentian (Extractum Gentianae)	0.1–0.6 gm.	grs. ii–x
Compound Tincture of Gentian (Tinctura Gentianae Composita)	2.0–16.0 c.c.	ʒ ½–iv

Gentian is often used as a mild laxative.

CALUMBA: The root of Jateorrhiza palmata, a climbing vine which grows in Mozambique.

Tincture of Calumba (Tinctura Calumbae)	4.0–15.0 c.c.	ʒi–iv

Calumba is often used in the treatment of thread worms.

CHIRATA: The herb and root of Swertia chirata, a plant growing in the northern part of India.

Fluidextract of Chirata (Fluidextractum Chiratae)	0.3–1.0 c.c.	m. v.–xv

BERBERIS: Barberry, a drug obtained from the root and berries of Berberis vulgaris, which grows in Europe. It contains an active principle, berberine, an alkaloid, and some tannin, which makes it contract mucous membrane slightly.

Fluidextract of Berberis (Fluidextractum Berberidis)	2.0 c.c.	m. xxx

QUASSIA: A drug obtained from the wood of Picraena excelsa, a large tree which grows in Jamaica. It contains an active principle quassin.

Fluidextract of Quassia (Fluidextractum Quassiae)	0.3–2.0 c.c.	m. v–xxx
Tincture of Quassia (Tinctura Quassiae)	1.0–4.0 c.c.	m. xv–3i
Quassin (not official)	0.015–0.03 gm.	grs. $\frac{1}{4}$–$\frac{1}{2}$

A 10% infusion of quassia is given as an enema for round worms in children.

TARAXACUM: Taraxacum is obtained from the root of the **Taraxacum officinale**, or ordinary dandelion.

It acts as a simple bitter and laxative. It also increases the flow of urine.

Preparations

Extract of Taraxacum (Extractum Taraxaci)	0.3–1.0 gm.	grs. v–xv
Fluidextract of Taraxacum (Fluidextractum Taraxaci)	4.0–8.0 c.c.	3i–ii

OTHER SUBSTANCES USED AS BITTERS

CONDURANGO: The bark of the condurango tree.

PAREIRA: The root of the **Chondodendron tomentosum**, a climbing plant of South America.

NUX VOMICA, CINCHONA, and their alkaloids, **strychnine** and **quinine** are also used as simple bitters, but their general effects are more important; under which they will be considered.

CETRARIN:	0.06–0.2 gm.	grs. i–iii

This is a bitter principle obtained from Iceland moss. It is said to increase peristalsis, and the secretion of saliva, bile and pancreatic juice.

OREXIN: This is an artificial chemical substance used as a bitter. It must not be given on an empty stomach, as it is somewhat injurious to the stomach.

AROMATIC BITTERS

The aromatic bitters increase the secretion of the lining membrane of the stomach more than the simple bitters do, on account of the volatile oils which they contain. Their effects are also more lasting, and they contract the mucous membranes, because of small quantities of tannic acid which many of them contain.

They should always be given before meals, best in fluid form undiluted, and their taste should not be disguised.

Aromatic Bitters and Their Preparations

SERPENTARIA: The root of the **Virginia snake root**, a small herb, which grows in the United States. This is often combined with other bitters.

Tincture of Serpentaria (Tinctura Serpentariae)	2.0–8.0 c.c.	3½–ii

OTHER SUBSTANCES USED AS AROMATIC BITTERS

Aurantii Dulcis Cortex (Sweet Orange Peel)

Aurantii Amari Cortex (Bitter Orange Peel)

Anthemis, Chamomile: The dried flowers of **Anthemis nobilis**, a European plant.

Matricaria, German chamomile: The flowers of **Matricaria, chamomilla**, German plant.

Eupatorium: The leaves and flowering tops of **boneset**, or **thoroughwort.**

Eucalpytus: The leaves of the **blue gum tree** of Australia.

CARMINATIVES

The following drugs are used principally to check the formation, and aid the expulsion of gas from the stomach and intestines. A drug which has such an action is called a **carminative.** The carminatives usually contain volatile oils, and most of them also act as aromatic bitters. They are occasionally used to check the griping pains often caused by cathartics. Because of the pleasant odorous oils which many of them contain, they are used to disguise the taste of unpleasant tasting drugs. Some of them are used as condiments with food.

Action

Local Action: Applied to the skin, they act as antiseptics; and in strong solutions, they cause redness, pain and swelling, and in strong preparations they may even cause blisters.

On mucous membranes, they cause redness and swelling. slight pain and smarting, with excessive secretion of mucus.

Internal Action

In the mouth, they produce a hot burning taste, and in large doses they cause redness of the lining membrane of the mouth, and an increased flow of saliva, which aids in the digestion of the food. At the same time they have a very pleasant aroma, and their antiseptic action is again manifested.

In the stomach and intestines, they cause a feeling of warmth, and a sense of comfort, and they relieve the feeling of distention after meals.

By their antiseptic action, they lessen the formation of gas, and by causing redness and swelling (irritation), of the lining membrane, they bring about contractions of the muscle wall of the stomach and intestines, and help to expel gas.

Many of the carminatives increase the appetite, and probably by their pleasant aroma, as well as by directly activating the lining membrane of the stomach and intestines, they increase the secretion of the digestive juices, and aid in the digestion of food.

Action after Absorption

Occasionally, some carminatives may cause effects after absorption (see preparations below).

Excretion

The carminatives are mostly excreted by the expired air and the urine, part of the drug being used up in the body, however.

In their passage through the lungs, they increase the flow of bronchial secretion, thereby increasing expectoration, and in their passage through the kidneys, they may increase the flow of urine (diuretic action).

Some drugs in the carminative group are given for these effects.

Carminatives and Their Preparations

CAPSICUM, Cayenne Pepper: The extremely pungent fruit of the **Capsicum fastigiatum**, or **African pepper.**

Capsicum causes marked redness and blistering of the skin, often destruction of the area of skin over which it is applied.

Internal Action

In large doses it often causes violent pain in the abdomen, with vomiting, followed by profuse diarrhoea and very painful urination.

Uses

Capsicum is used to increase the secretion of the stomach, particularly in patients suffering from chronic alcoholism. In such patients the lining membrane of the stomach is so affected that it secretes very little gastric juice.

It is also used in the form of a plaster to produce blisters, in order to draw fluid from deeper tissues into the skin.

Tincture of Capsicum (Tinctura Capsici)	2.0–4.0 c.c.	m. xxx–3i
Capsicum Plaster (Emplastrum Capsici)	For local use	

ZINGIBER, Ginger: The dried roots of the **Zingiber officinale**, which grows in the East and West Indies. Green

ginger is the fresh, and black ginger, the dried roots. The fresher it is, the more active is the ginger.

Tincture of Ginger (Tinctura Zingiberis)	2.0–4.0 c.c.	ʒ ss–i

CARDAMOMUM, Cardamom: This is a drug obtained from the fruit of the **Elettaria repens,** which grows in the East Indies.

Tincture of Cardamomum (Tinctura Cardamomi) 2%	2.0–4.0 c.c.	m. xxx–ʒi
Compound Tincture of Cardamom (Tinctura Cardamomi Composita)	4.0–8.0 c.c.	ʒi–ii

ASAFOETIDA: This is a gum resin obtained by incising the root of the **Ferula narthex,** a plant which grows in Afghanistan in India. It consists of a gum resin and a volatile oil which is the active principle. Asafoetida is frequently used in India as a condiment.

Action

In the mouth: It has a very unpleasant nauseous taste, and an odor resembling garlic.

In the stomach: It checks the formation and aids the expulsion of gas (carminative action), and it increases the secretions. **In the intestines:** It increases the secretions and peristalsis and helps to expel gas. It causes frequent movements of the bowels.

It is used principally to remove gas from the intestines. It is frequently given in an enema.

Because of its unpleasant taste, which causes a psychical effect it is occasionally given to quiet hysterical patients.

Preparations

Emulsion of Asafoetida (Emulsum Asafoetidae)	15.0–30.0 c.c.	℥ ½–i

This is given by mouth, or in an enema; to relieve distention.

Tincture of Asafoetida (Tincture Asafoetidae)	1.0–2.0 c.c.	m. xv–xxx

Pills of Asafoetida 1 –3 pills
(Pillulae Asafoetidae)

Each pill contains 0.2 gm. (grs. iii) of asafoetida.

Other Carminatives

Chloroform water, Hoffman's anodyne (Compound spirits of ether), and a number of alcoholic preparations, such as curacoa, Cherrywater (kirschwasser) kummel, whiskey, rum, gin, etc., are occasionally used as carminatives.

EMETICS

Drugs which Produce Vomiting

Vomiting is an act whereby the stomach violently expels its contents. The strain of continued vomiting usually makes the patient very weak, and often produces symptoms of collapse.

The patient is then very pale, his skin is cold and covered with perspiration, the pulse is rapid, weak and thready; his breathing is slow and shallow, the pupils are dilated and the patient complains of great weakness.

Physiology of Vomiting

Drugs produce vomiting in two ways:

1. By greatly increasing the activity of the lining membrane of the stomach (irritating), the muscular wall of the stomach contracts very forcibly, thus expelling the stomach contents.

2. Some drugs cause vomiting after they are absorbed into the blood. These are carried by the circulation, to an area of gray matter in the medulla of the brain, whose function is to produce vomiting (the vomiting center), and cause this center to send impulses to the muscle wall of the stomach to contract, and thereby produce vomiting.

IPECAC

Ipecac is a drug obtained from the roots of the **Cephaelis ipecacuanha**, a wild plant growing in Brazil, Colombia and other parts of South America.

Its active principles are the **alkaloids:**

Emetine
Cephaeline
Psychotrine

The vomiting is due principally to the cephaeline and partly to the emetine.

Appearance of the Patient

If a patient is given a moderately large dose of one of the preparations of ipecac, a very short time after the administration he feels nauseated and vomits profusely. The vomiting is usually accompanied by profuse secretion of saliva, of tears, and of mucus from the bronchi. Occasionally, if the entire amount of drug is not completely excreted in the vomited matter, it may cause profuse diarrhoea and symptoms of mild collapse: rapid pulse, slower respiration, and cold moist skin.

ACTION

Local Action: On the skin ipecac produces redness, itching and small pustules.

On the mucous membranes: On the eye it causes slight redness and swelling with a profuse flow of tears. In the nose it causes profuse secretion and continual sneezing.

Internal Action

In the mouth: It increases the flow of saliva.

In the stomach: Ipecac acts principally on the lining membrane of the stomach, causing redness and swelling (irritation) with an excessive secretion. This causes the muscle wall of the stomach to contract violently, thereby producing vomiting. The vomiting continues, until all the ipecac in the stomach is entirely expelled.

In the intestines: The action on the intestinal tract is similar to that in the stomach; the lining membrane becomes red, swollen and secretes an excessive amount of mucus, thereby producing contractions of the muscle wall of the intestines which result in profuse diarrhoea. The stools often contain blood, from the excessive irritation.

Action after Absorption

Some of the ipecac is rapidly absorbed from the stomach. It then acts principally on all the mucous membranes. On the mucous membrane of the bronchi, it causes a profuse

secretion of mucus. (It is commonly given in cough mixtures for this effect, especially to children, to increase expectoration).

On the mucous membrane of the eye and nose it produces the same effects as when applied locally. It also increases the secretion of sweat.

The symptoms of collapse, which occasionally result after large doses of ipecac, are usually due to the great strain of continual vomiting.

Specific Action

Ipecac is now used as a specific for Amoebic Dysentery and in Pyorrhoea alveolaris. The effect is due to the **emetine,** which destroys the amoeba, a single celled animal organism which is the cause of the former, and is found in the secretions of the latter disease.

For its specific action ipecac should be given in keratin coated pills so as to avoid its action on the stomach and thereby to prevent vomiting.

Excretion

Ipecac is usually excreted by the stomach in the vomited matter, and does not therefore produce any poisonous symptoms.

Preparations

Solid Preparations

Powdered Ipecac, as emetic	2.0 gms.	grs. xxx
(**Pulvis Ipecacuanhae**) as expectorant	0.06–0.3 gms.	grs. i–v
Powdered Ipecac and Opium (**Pulvis Ipecacuanhae et Opii**) (Dover's powder) (Contains 10% opium and 10% ipecac)	0.3 –1.0 gm.	grs. v–xv

Fluid Preparations

Fluidextract of Ipecac, as emetic (**Fluidextractum Ipecacuanhae**)	1.0–2.0 c.c.	m. xv–xxx
as expectorant	0.2–0.5 c.c.	m. iii–viii

The following two preparations are given mostly to children.

Syrup of Ipecac	for infant as emetic	
(Syrupus Ipecacuanhae)	2.0–4.0 c.c.	$3\frac{1}{2}$–i
(7% of fluidextract)	as expectorant	
	0.1–1.0 c.c.	m. ii–xv

Wine of Ipecac	for a child as emetic	
(Vinum Ipecacuanhae)	2.0–4.0 c.c.	$3\frac{1}{2}$–i
(10% of fluidextract)	as expectorant	
	0.1–1.0 c.c.	m. ii–xv

Active Principles

Emetine Hydrochloride	0.02–0.06 gm.	gr. $\frac{1}{3}$–i

This has recently been used with brilliant results in the treatment of amoebic dysentery. It is given hypodermically in small doses and by mouth in the maximum dose.

Administration

If given to produce vomiting, it is best to dilute ipecac preparations in warm water.

If given as an expectorant, especially to croupy children, the preparations should be given in syrup.

APOMORPHINE

Apomorphine is an artificial alkaloid, made from morphine, one of the alkaloids of opium. An acid is added to the morphine to take out some of its water, thus forming apomorphine. (The process is called dehydration.)

Appearance of the Patient

When a moderate dose of apomorphine is administered hypodermically, within ten to fifteen minutes after it is given, the patient feels nauseated and vomits profusely. At the same time, there is a profuse secretion of tears, of mucus from the nose and bronchi, and the skin is covered with cold perspiration. These symptoms are always produced by any drug which causes vomiting. There is usually a great deal of weakness after apomorphine is administered, at times very profound collapse: a rapid, thready pulse, slow and shallow respiration, cold perspiration and dilated pupils. The collapse has seldom been fatal, however.

ACTION

Apomorphine has no local action.

Internally: Small doses often increase the secretions of all the mucous membranes without producing vomiting, and they are often given for this effect.

Mode of action: Apomorphine produces vomiting, by causing the vomiting center in the brain to send impulses to the stomach to cause its muscle wall to contract and thereby expel its contents.

Excretion: It is excreted by the stomach in the vomited matter.

Preparations

Apomorphine Hydrochloride, (**Apomorphinae Hydrochloridum**)	as emetic 0.006–0.012 gm.	gr. $\frac{1}{10}-\frac{1}{5}$
	as expectorant 0.002–0.004 gm.	gr. $\frac{1}{30}-\frac{1}{15}$

Apomorphine is usually given hypodermically.

MUSTARD

This is frequently used to produce vomiting. About a teaspoonful to a tablespoonful of mustard is given in a glass of tepid water. The dose should be repeated in fifteen or twenty minutes if vomiting does not occur.

ANTIMONY

Antimony is a metal. Many of its preparations are used in medicine, principally to produce vomiting.

ACTION

Applied to the skin, antimony causes redness, and in strong solutions it produces blisters or pustules.

When given internally, it causes profuse continuous vomiting and increases the secretions of all the mucous membranes and the sweat. On account of the collapse which follows its use, it is not often used.

Overdoses usually cause profuse vomiting and diarrhoea, with profound collapse.

Preparations

Tartar Emetic, as a diaphoretic and expectorant	0.002–0.008 gm.	gr. $\frac{1}{30}$–$\frac{1}{8}$
(Antimonii et Potasii Tartaras) as an emetic	0.03 –0.1 gm.	grs. $\frac{1}{2}$ – ii

This preparation is also contained in the compound syrup of squills.

Wine of Antimony, as a diaphoretic	0.6– 2.0 c.c.	m.x–xxx
(Vinum Antimonii) as an emetic	4.0–15.0 c.c.	ʒi–iv

Contains 4 parts of Tartar Emetic to 1000.

Other Drugs Used to Produce Vomiting

Zinc Sulphate	0.6–2.0 gms.	grs. x –xxx
Copper Sulphate	0.2–0.3 gm.	grs. iii–v

Copper sulphate is the best emetic to use in cases of Phosphorus poisoning.

Alum	0.5 gm.	grs. viii

Alum is best given in molasses or in the syrup of ipecac.

Turpeth Mineral (Yellow Mercurous Subsulphate) **Hydrargyri Subsulphas Flavus** (not official)	0.06–0.3 gm.	grs. i–v

This is given every ten or fifteen minutes until free vomiting occurs.

Warm water given continuously will also cause vomiting.

Salt (sodium chloride) is given in solid form or in concentrated solutions to produce vomiting.

Mustard is frequently used to produce vomiting. A teaspoonful to a tablespoonful of the mustard powder is given in tepid water, and is repeated in fifteen to twenty minutes if no effects were produced.

CHAPTER IX

CATHARTICS

(Intestinal Stimulants)

Cathartics are drugs which are used to move the bowels. Many drugs which produce various effects on the different organs of the body, may also increase the movements of the bowels, but the drugs here considered, are those which are used principally for this effect.

Mode of Action

Movements of the bowels are brought about by the contractions of the involuntary muscles of the intestines (peristalsis). This is caused in the following ways:

1. When the intestines fill up with solid, fluid or gaseous matter. This causes contractions of the intestinal muscles, thus producing movements of the bowels.

2. When drugs cause redness and swelling of the mucous membrane of the intestines (irritation). This not only causes an increased secretion of mucus, which helps to fill up the intestines, but also affects the nerve endings in the wall of the intestines. Impulses are thus sent along the afferent nerve fibers to the spinal cord, which immediately sends back other impulses to the intestinal muscles to cause them to contract, and movements of the bowels result. (Such an action is called a reflex action).

Frequent movements of the bowels are often accompanied by violent cramp-like pains in the abdomen (griping), due to contractions of the involuntary muscles of the intestines which accompany such movements.

To overcome the griping, many cathartics are often combined with other drugs which lessen intestinal peristalsis.

For example—lapactic pills are very efficient commonly used cathartics. They contain the extract of belladonna

to overcome the griping which they might otherwise produce.

3. Many cathartics, such as the salines, draw fluid into the intestines from the blood and tissues; thereby filling up the intestines with fluid, which is expelled by the resulting contractions of the intestinal muscles. At the same time, fluid is thus removed from the blood and tissues so that oedema (fluid in the tissues) may be lessened and the blood pressure reduced.

Administration

Cathartics which produce mild effects, or which produce their effects slowly, should be given at night. Those which produce rapid effects, should be given in the morning.

Cathartics should never be given after meals as they may cause vomiting.

Cathartics which cause violent action should not be given in cases where the intestine is diseased.

For example—In **typhoid fever** or **acute appendicitis** violent cathartics should be avoided. In typhoid fever an active cathartic may increase the inflammation in the ulcers which are present in the intestinal mucous membrane in this disease. The violent contractions which result from such a cathartic may increase the tendency to haemorrhage and perforation.

In cases of **acute appendicitis** the appendix may be very friable, and the violent contractions which result from many cathartics may cause a rupture of the appendix.

In cases that have had an abdominal operation performed upon them, **the nurse should never administer a cathartic without the doctor's order.**

When the operation has been performed upon the stomach or intestines, the greatest care must be exercised in giving cathartics, for example—in operations for the removal of the vermiform appendix, the removal of a part of the stomach and intestines or the suturing (sewing) of any of these organs. **In such cases no cathartic should be administered before the third day after the operation,** because the violent intestinal contractions may tear the delicate stitches in the wall of the intestines, and cause perforations with resulting peritonitis, that may be fatal.

Classification

Cathartics may be divided into the following three classes, depending upon whether they cause **mild action, moderate action,** and **more violent action:**

1. **Laxatives**
2. **Purgatives** (Simple and Saline)
3. **Drastic Purgatives**

This distinction is not very well defined; since some cathartics produce mild effects in small doses, and greater, even violent effects in larger doses; but the classification here given is according to the effects produced by the doses usually administered, and is the most practical one.

Cathartics may also be classified according to the part of the intestine they affect; the entire intestine, the duodenum, the small intestine or the large intestine. Another classification consists in grouping them according to their active principles.

LAXATIVES

Laxatives or aperients are medicines which cause a few movements of the bowels. The stools are formed, normal in character, and the movements are not accompanied by griping.

Acting on the Entire Intestine

Many foods which leave a great deal of residue or undigested material, act as laxatives. Such foods as oatmeal, wheat, bran and many fruits are distinctly laxative. These may be given at night slightly flavored with sugar. Large quantities of water is also a good laxative. The following are the substances commonly used as laxatives:

MOLASSES (Syrupus Fuscus)

MILK SUGAR (Saccharum Lactis)

GLYCERIN (Glycerinum)

Glycerin is a very good laxative; given in doses of one to two ounces.

MANNA: Manna is a drug obtained from the sap of the European ash tree which grows chiefly in Sicily and Calabria. It is given in doses of 15.0–60.0 gms. (ʒ½–ʒii.)

Manna is used as a mild laxative, very often combined with other purgatives.

TAMARIND: Tamarindus or tamarind is the preserved fruit of the **Tamarindus indica,** a tree growing in the East or West Indies. It is eaten like preserves, and is a very good laxative.

CASSIA FISTULA: Cassia fistula, or purging cassia, is the fruit of the cassia fistula tree of East India and Egypt. It is used as a laxative in doses of 4.0–30.0 gms. (ʒi–ʒi.)

SULPHUR (Brimstone). This is an inorganic element found in volcanoes. Many of its preparations are used as laxatives.

Washed Sulphur (Sulphur Lotum)	1.0–4.0 gms.	grs. xv–ʒi
Precipitated Sulphur (Sulphur Praecipitatum)	4.0–15.0 gms.	ʒi–iv
Sublimed Sulphur, or Flowers of Sulphur (Sulphur Sublimatum)	4.0–15.0 gms.	ʒi–iv

Sulphur is best given in a small quantity of syrup.

AGAR AGAR

Agar agar is a substance made from various seaweeds of the East Indies.

It is used as a purgative. It withdraws fluid from the stomach and intestines, forming a large jelly-like mass, which is indigestible, and increases the size of the fecal masses, so that the intestines become distended.

The distention of the intestines produces frequent strong contractions of its muscle wall (peristalsis), which result in frequent movements of the bowels.

Agar agar is given in milk, and is eaten like oatmeal gruel or any other cereal.

Preparations

Agar Agar	4.0–15.0 gms.	℥i–℥½

Regulin is a preparation of agar agar with cascara, and is given in the same doses.

Agar Agar with Calumba
Agar Agar with Gentian
Agar Agar with Phenolphthalein
(Einhorn)

LIQUID PETROLATUM, MINERAL OIL

Liquid Petrolatum, Mineral Oil or Liquid Paraffin is a heavy oily substance which is obtained from petroleum oil. Chemically it belongs to the group of hydrocarbons. It is on the market under various names: Liquid Vaseline; Liquid Albolene, etc. Russian mineral oil is the same substance obtained from Russia, but is much heavier than the American product.

ACTION

Applied locally mineral oil is bland and soothing to the skin and mucous membranes.

When taken internally it is not absorbed. When it enters the intestines it becomes mixed with the intestinal contents which it protects from the action of the digestive juices. The water of the intestinal contents is therefore not absorbed and the mass of foeces gradually becomes increased. This distends the intestines and bowel movements result. At the same time it lubricates the mucous membrane of the intestines.

Mineral oil is used as a laxative especially in chronic constipation; which is frequently due to a weakened condition of the intestinal muscles or to delicate kinks or adhesions of the intestines.

It is given in doses of 15.0–30.0 gms. (℥ss–i), two or three times a day.

It occasionally causes nausea and it frequently has a tendency to ooze from the rectum between stools.

Administration

Liquid Petrolatum or mineral oil should be given about two or three hours after meals, undiluted. As it has a bland taste, which patients usually do not like, it should be flavored with some aromatic substance such as peppermint or cinnamon water.

Acting on the Duodenum

FEL BOVIS (Ox gall): Fel bovis is dried bile, obtained from the ox. It is used as a mild laxative and to increase the flow of bile.

Preparations

Purified Ox gall (Fel Bovis Purificatum)	0.3–1.2 gm.	grs. v–xx

LEPTANDRA: Leptandra is obtained from the roots and underground roots of the **Veronica virginia**, an American plant.

It is used as a mild laxative. The stools often contain a great deal of bile.

Preparations

Extract of Leptandra (Extractum Leptandrae)	0.1–0.25 gm.	grs. ii–iv

Acting on the Small Intestine

OLIVE OIL (Oleum Olivae)

Olive oil acts as a very good laxative in wineglassful doses. It is said to increase the flow of bile.

EUONYMUS: Euonymus or Wahoo, is the bark of the **Euonymus atropurpureus**, the spindle tree, growing in America.

It is used as a mild laxative.

Preparations

Extract of Euonymus (Extractum Euonymi)	0.06–0.2 gm.	grs. i–iii

Acting on the Large Intestine

CASCARA: Cascara sagrada is obtained from the bark of the **California buckthorn.** Its official name is **Rhamnus purshianae.** It acts on the large intestine and is one of the best laxatives. It is usually given at night, and produces a normal stool the next morning without griping. It is often given for habitual constipation.

Preparations

Extract of Cascara Sagrada (**Extractum Rhamni Purshianae**)	0.25 gm.	grs. iv
Fluidextract of Cascara Sagrada (**Fluidextractum Rhamni Purshianae**)	1.0 c.c.	m. xv

FRANGULA: Frangula is obtained from the bark of the **European buckthorn** or **Rhamnus frangula.**

Preparations

Fluidextract of Frangula (**Fluidextractum Frangulae**)	1.0–2.0 c.c.	m. xv–xxx

PURGATIVES

Purgatives are drugs which produce frequent movements of the bowels, with soft stools accompanied by griping.

There are two kinds of purgatives: **Simple and Saline.**

1. **Simple purgatives** are plant or other substances which cause frequent movements of the bowels.

2. **Saline purgatives** are inorganic (mineral) salts used as purgatives. These are often called **hydragogue cathartics** because they produce very frequent watery stools.

Many purgatives are also called **cholagogue cathartics** because the stools resulting from their use are highly colored with bile. This is due to the fact that they act mainly on the duodenum or first part of the small intestine, and therefore also bring about contractions of the bile ducts, which pour more bile into the intestine. They do not increase the secretion of bile.

SIMPLE PURGATIVES

Large doses of the laxatives act as purgatives.

Acting on the Duodenum

CALOMEL: HYDRARGYRI CHLORIDUM MITE

Calomel is a compound of mercury; the mild mercurous chloride.

ACTION

Calomel is used principally as a purgative. It produces frequent soft stools, very highly colored with bile, and it is often called, therefore, a cholagogue cathartic.

It acts principally on the duodenum, the first part of the small intestine. It causes redness and increased secretion of the lining membrane of the intestine (irritation), which brings about contractions of its muscle wall (peristalsis). It thus also induces contractions of the bile ducts, which are closely attached to the duodenum or first part of the small intestine. The flow of bile into the intestine is then increased and the stools contain a great deal of bile. Calomel also acts as an antiseptic in the intestines, checking the growth of bacteria. It has a decided tendency to produce griping.

It is also used to increase the flow of urine (diuretic action).

Preparations

Calomel (Hydrargyri Chloridum Mite)	0.008–0.3 gm.	gr. $\frac{1}{8}$–v

Administration

Calomel may be given in small doses, frequently repeated. For example, gr. $\frac{1}{4}$ every fifteen minutes until two grains are taken, or the two grains may be given in one single dose. It is often given with sodium bicarbonate; about grs. v of sodium bicarbonate with every gr. $\frac{1}{2}$ of calomel to lessen the griping.

Calomel should be given between meals or at night. It should always be followed by a dose of one of the saline cathartics, so that the calomel will not remain in the intestines. Otherwise it may be changed to corrosive sublimate in the intestines and cause the following poisonous symptoms: a metallic taste in the mouth, abdominal pain, nausea, vomiting, diarrhoea with bloody stools, and collapse (rapid, weak, thready pulse, slow, shallow respiration, cold, moist skin, dilated pupils).

Milk, eggs and other albuminous food should not be given shortly after calomel.

BLUE MASS—MASSA HYDRARGYRI

This is a compound of mercury and is a milder purgative than calomel. It is always given in pill form, each pill containing about grs. iii–v of blue mass.

Blue Mass (Massa Hydrargyri)	0.06–0.3 g.m	grs. i–v

MERCURY WITH CHALK, GRAY POWDER, HYDRARGYRUM CUM CRETA

This preparation is made of metallic mercury, with chalk and honey. It is always prescribed in powder form. It is milder than calomel. The chalk lessens the griping.

PODOPHYLLUM

Podophyllum is the underground root and rootlets of the **Podophyllum peltatum,** the May apple or mandrake, a perennial plant growing in Northern and Middle United States. Its active principle is a resin, **podophyllin.** It also contains an alkaloid, berberine.

ACTION

Podophyllum causes frequent copious bile stained stools about eight to twelve hours after it is given. This is the result of its action on the duodenum. Since the bile ducts are attached to this part of the intestine, the flow of bile is also

increased, and the stools are therefore stained with bile; podophyllum is often called vegetable calomel because it causes similar stools.

It also causes bowel movements when given hypodermically as it is eliminated by the mucous membranes of the intestine.

In poisonous doses the frequent stools may cause great exhaustion and collapse.

Preparations

Resin of Podophyllum (Resina Podophylli)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i
Pills of Podophyllum Belladonna and Capsicum (Pilulae Podophylli Belladonnae et Capsici)		1 pill
Podophyllin (Unofficial)	0.005–0.01 gm.	gr. $\frac{1}{12}$–$\frac{1}{6}$

Acting on the Small Intestine

CASTOR OIL—OLEUM RICINI

Castor oil is a fixed oil (an oil which does not evaporate), obtained from the seeds of the **Ricinus communis**, a tree growing in all warm countries. The seeds are warmed, and the oil is then pressed out of them. The oil ordinarily used, is obtained from Calcutta in India.

Castor oil has no odor, but a very unpleasant nauseating taste.

The active principle of castor oil is **ricinoleic acid**, and its compounds **ricinoleates.** Old castor oil contains more ricinoleic acid, and is therefore often more efficacious.

ACTION

Local Action: On the **skin** and **mucous membranes,** castor oil is very soothing.

Internal Action

In the mouth: It has an unpleasant nauseating taste. Even its smell will sometimes produce nausea.

In the intestines: Castor oil produces frequent movements of the bowels in about three to six hours, not accompanied by griping. The stools are soft, but after the movements have occurred, the bowels are apt to be constipated.

Castor oil is decomposed by the digestive juices, forming ricinoleic acid. This forms compounds with the alkaline salts in the intestines (ricinoleates). These substances slightly increase the intestinal secretions, and affect the nerve endings of the intestinal wall. Impulses are thus sent to the spinal cord, to bring about contractions of the muscle wall of the intestines, thereby causing frequent movements of the bowels. (An action brought about in this way is called a reflex action).

The ricinoleates which are formed in the intestine, are absorbed into the blood, and are then excreted by all the secretions. Because it is eliminated in the milk, castor oil often acts as a laxative on nursing infants.

Castor oil is one of the best cathartics for temporary use; because of its soothing after effect which produces constipation.

Preparations

Castor Oil	15.0–30.0 c.c.	℥ss–i
(Oleum Ricini)		
For an infant	4.0– 8.0 c.c.	ʒi–ii

Laxol: This is a tasteless preparation of castor oil (not official).

Castor oil is also put up in flexible capsules, to disguise its unpleasant taste.

(The castor oil bean is never used because it contains a very poisonous substance, ricin.)

Administration

In giving castor oil the unpleasant taste must be disguised. To some people, however, the taste is not at all unpleasant. For example: the Chinese are very fond of castor oil and do not mind its taste, in fact, they use it as a food.

Castor oil should always be given cold, as the taste is then

not as readily appreciated. The object of disguising the taste is to coat the oil with a substance which will make the oil taste more pleasant. This may be done in the following ways:

1. By giving the oil in an equal part of glycerin or brandy.
2. By making an emulsion of the oil by pouring it into flavored soda water, sarsaparilla or grape juice.
3. The patient's mouth may be rinsed out with a little whiskey or peppermint, before giving the castor oil.
4. It may be poured between two layers of lemon juice, grape juice, orange juice, or whiskey, as in the following method:

Castor Oil Cocktail

Rinse out the medicine glass with some whiskey or lemon juice, and pour about a teaspoonful of lemon juice in the bottom of the glass. The castor oil is then added; and on top of that, a teaspoonful of whiskey, raspberry juice or peppermint. The mixture is then administered.

A little vichy or seltzer, or an olive, will often remove the unpleasant nauseous feeling which follows the taking of a dose of castor oil, even when its taste is disguised.

Acting on the Large Intestine

RHUBARB

Rhubarb is obtained from the root of the **Rheum officinale,** a plant growing in China and Tartary. The plant is similar to the ordinary rhubarb, but is much larger.

ACTION

Rhubarb acts principally upon the large intestine as a purgative, producing frequent fluid stools, not accompanied by griping. These stools are colored with bile. On account of the tannic acid which it contains, rhubarb constipates after its purgative action.

The urine, and in nursing women, the milk, is colored yellow when rhubarb is taken.

Rhubarb is particularly valuable in cases where solid masses in the stools produce pain. For example, in haemor-

rhoids, by softening the stools, the pain produced by the passage of hard fecal masses, is often relieved.

Preparations

Extract of Rhubarb (Extractum Rhei)	0.3–0.6 gm.	grs. v–x
Compound Rhubarb Pill (Pilula Rhei Composita) (This contains aloes, myrrh, oil of peppermint and rhubarb)	1–5 pills	
Compound Rhubarb Powder (Pulvis Rhei Compositus) (Gregory's powder) (This contains magnesia, ginger and rhubarb)	1.0–4.0 gms.	grs. xv–ʒi
Aromatic Syrup of Rhubarb (Syrupus Rhei Aromaticus)	2.0–8.0 c.c.	ʒss–ii for a child.
Rhubarb and Soda Mixture (Mistura Rhei et Sodae)	8.0 c.c.	ʒii

This also contains ipecac and is used more for stomach conditions than as a cathartic.

ALOES

Aloes is the dried juice of several species of **Aloes,** a plant growing in the Barbadoes, and other islands in the Indian Ocean and in Arabia. It is one of the oldest drugs in medicine. It was used in the time of Alexander the Great, about 300 B. C.

The preparations are made up from the **Barbadoes** and **Socotrine Aloes,** obtained from the Barbadoes, and the Island of Socotra. The active principle is **aloin,** which belongs to a number of substances known as the anthracene group because they are all similar to anthracene, a substance obtained from coal tar.

ACTION

Aloes acts principally on the large intestine, causing irritation, with dilatation of the blood vessels. This action

results in peristalsis, causing frequent movements of the bowels.

Administration

Aloes is seldom administered alone. It is usually given together with other purgatives.

Preparations

Solid Preparations

Pill of Aloes 1–5 pills
(Pilulae Aloes)
Each pill contains 0.12 gm. (grs. ii) of aloes

Pills of Aloes and Iron 1–5 pills
(Pilulae Aloes et Ferri)
Each pill contains 0.12 gm. grs. ii of aloes

Pills of Aloes and Mastiches 1–5 pills
(Pilulae Aloes et Mastiches)
(Lady Webster's dinner pill.) Each pill contains grs. ii of aloes

Pills of Aloes and Myrrh 1–5 pills
(Pilulae Aloes et Myrrhae)
(Rufus' pill.) Each pill contains 0.12 gm. grs. ii of aloes

Aloin (active principle) 0.015 gm. gr. $\frac{1}{4}$
(Aloinum)

Lapactic Pills or A. B. & S. pills dose 2 pills
(Pilulae Laxativae Compositae)
Each pill contains,

Aloin	gr. $\frac{1}{4}$
Extract of Belladonna	gr. $\frac{1}{8}$
Strychnine	gr. $\frac{1}{120}$
Powdered Ipecac	gr. $\frac{1}{15}$

Fluid Preparations

Tincture of Aloes 2.0–8.0 c.c. ʒss–ii
(Tinctura Aloes)

Aloes is also contained in the **compound rhubarb pill, compound extract of colocynth,** and **compound tincture of benzoin.**

SENNA

Senna is obtained from small dried leaves of an oriental shrub.

There are two kinds of senna plants: **Cassia acutifolia,** which comes from Alexandria in Egypt, and **Cassia angustifolia,** from India. The active principle of senna belongs to the same group of substances (anthracene derivatives) as aloin.

ACTION

Senna acts principally on the large intestine, producing in five hours after it is given, frequent watery stools, usually accompanied by severe griping pains.

To overcome the griping, it is usually combined with other substances, especially carminatives.

It is excreted in the urine. In nursing women it is excreted in the milk, and it will then act as a laxative on the nursing infant.

Senna in small doses is often given to children as a laxative.

Preparations

Confection of Senna (Confectio Sennae) 4.0–8.0 c.c. ʒi–ii

Containing senna, cassia fistula, tamarind, prune, fig, sugar and oil of coriander.

Compound Infusion of Senna (Black Draught) (Infusum Sennae Compositum) 30.0–120.0 c.c. ℥i–iv

Contains senna, manna, magnesium sulphate and fennel.

Syrup of Senna (Syrupus Sennae) 4.0–16.0 c.c. ʒi–iv

Senna tea is a preparation often given to children. It is an infusion of senna leaves, made from a teaspoonful of leaves to a cup of water.

PHENOLPHTHALEIN

Phenolphthalein is a chemical substance made from carbolic acid, phthalic anhydride and sulphuric acid.

It is used in the laboratory to test the reaction of various substances, since it turns red when an alkali is added to it.

ACTION

Phenolphthalein acts as a very good purgative, producing frequent soft stools with little griping. It acts on the large intestine, increasing peristalsis and preventing absorption of fluids, thus causing bowel movements.

Preparations

Phenolphthalein	0.1–0.2 gm.	grs. ii–iii

Acting on the Entire Intestine

GLYCYRRHIZA, LICORICE ROOT

Licorice is the root of **Glycyrrhiza glabra**, an English plant. Its active principle is a glucoside, **glycyrrhizin.**

Applied to the skin it is soothing and protecting (demulcent). Taken internally it is a mild purgative.

Preparations

Compound Licorice Powder (**Pulvis Glycyrrhizae Compositus**)	4.0 gms.	ʒ i

This contains senna, licorice root, sulphur, fennel and sugar. It should be given in very little water, as it may cause nausea, but it should always be followed by a drink of water.

Licorice powder is best given at bedtime. It is an excellent purgative, producing frequent fluid stools without griping, in about ten to fifteen hours; or in three to six hours, when given on an empty stomach.

It is especially valuable in patients suffering from haemorrhoids. The fluid stools resulting from licorice powder lessen the pain produced by movements of the bowels in cases of haemorrhoids.

HORMONAL

(not official)

Hormonal is a fluid substance prepared from the spleen of a rabbit about an hour after being fed a heavy meal.

It causes movements of the bowels when injected intravenously or intramuscularly. It is used as a cathartic when the bowels are distended after an operation, or in cases of chronic constipation. It is given in doses of 15–40 c.c. The injections are frequently followed by collapse.

ESERINE OR PHYSOSTIGMINE

Eserine or Physostigmine is frequently given hypodermically to move the bowels and relieve distention, especially after operations. It acts by increasing the peristalsis of the intestinal muscle. It may cause collapse.

SALINE PURGATIVES

Saline purgatives are inorganic (mineral) salts used as purgatives. They are all combinations of alkalies with acids. Only those salts are used which are not readily absorbed. The saline purgatives all act on the entire intestine.

Action

Locally: The saline purgatives produce no effect.

In the mouth: Most of the saline purgatives have a harsh unpleasant bitter taste.

In the stomach: They often produce nausea and vomiting.

In the intestines: They produce frequent fluid stools accompanied by griping.

Mode of Action

When given in small doses, or in dilute solutions, so that the percentage of salt in the intestine is less than that in the blood (anisotonic), or equal to that in the blood (isotonic), the salts are not absorbed, but they prevent the passage of fluids through the lining membrane of the stomach and intestines (absorption). This fluid then distends the intestines,

especially the large intestine, causing contractions of their muscle wall with resulting fluid stools.

When given in larger doses, or in concentrated solutions, so as to make the percentage of salt in the intestines greater than that in the blood (hypertonic), the salts are not absorbed. They merely withdraw fluid into the intestines from the blood and tissues by the process of osmosis until the salt in the intestines becomes diluted sufficiently; that is, until it contains the same percentage of salt as the blood (isotonic). By this time the quantity of fluid in the intestines has increased to such an extent that the intestines, especially the large intestine, become distended and frequent watery stools result.

Since the withdrawal of fluid from the tissues takes considerable time, bowel movements from concentrated salt solutions may occur only after ten or twenty hours. On the other hand, dilute solutions, because they are not absorbed, but merely distend the intestines, usually induce much more rapid effects.

The saline cathartics are particularly valuable in cases where there is a great deal of fluid in the tissues (oedema), for example, to reduce oedema of the legs in nephritis, or to reduce ascites (fluid in the abdomen). In such cases they withdraw the fluid from the tissues into the intestines, and the frequent movements of the bowels which result, eliminates this excessive fluid, relieving the oedema or the ascites.

Saline cathartics are also given to reduce blood pressure, because they withdraw fluid from the blood. By lessening the total quantity of blood in the body, blood pressure is reduced.

The saline cathartics should not be given in cases where there are ulcers or inflammation in the intestines, as they may aggravate this condition.

A small portion of each dose of some of the salines is absorbed, and acts on the kidneys as a diuretic, increasing the flow of urine.

Administration

The saline cathartics are best given well diluted, pref-

erably in the morning, when the stomach is empty. They move the bowels in a few hours.

To relieve oedema they should be given in a concentrated solution, since more fluid is thus removed, and the effect is more prolonged.

The preparations of the saline purgatives are best given in cold seltzer or vichy. If they are given hot, the addition of 10 or 15 drops of tincture of ginger makes them taste more agreeable. They should not be given stronger than 5–10% solutions.

Preparations

Salts of Sodium

Sodium Sulphate (Glauber's Salt) 2.0–30. gms. ʒ½–ʒi
(Sodii Sulphas)

This is soluble in 3 parts of water. This is best given in solution, in vichy or seltzer, not stronger than 5–10% solutions.

Sodium Phosphate 1.0–30.0 gms. grs. xv–ʒi
(Sodii Phosphas)

This is soluble in 6 parts of water.
It is best given in milk, not stronger than 5–10% solutions.

Salts of Potassium

Potassium Sulphate 1.0–4.0 gms. grs. xv–ʒi
(Potassii Sulphas)

Potassium Bitartarate (Cream of tartar)
(Potassii Bitartaras) 1.0–4.0 gms. grs. xv–ʒi

Potassium and Sodium Tartarate (Rochelle Salt)
(Potassii et Sodii Tartaras) 8.0–16.0 gms. ʒii–iv

This is soluble in 1½ parts of water. It tastes pleasanter than Epsom salts.

Salts of Magnesium

Magnesia Oxide, Calcined Magnesia, or Light Magnesia
(Magnesii Oxidum) 2.0–4.0 gms. grs. xxx–ʒi

Magnesia is very mild in action.

Magnesium Sulphate (Epsom salt)
(Magnesii Sulphas) 2.0–30.0 gms. ʒ½–ʒi

This is soluble in 1½ parts of water.

Magnesium sulphate is very commonly used. It has a very unpleasant taste and is best given in seltzer or vichy.

Large doses produce very frequent stools, with a good deal of griping.

The preparations of magnesia are best given in powder form, sweetened to disguise the taste.

Carlsbad Salt
(Sal Carolinum)

This is a mixture of the mineral salts obtained by evaporating the water of the carlsbad mineral spring in Bohemia.

Artificial Carlsbad Salt
(Sal Carolinum Factitium)

This is a mixture of the salts contained in natural carlsbad salts, and consists of the following salts:

Dried Sodium Sulphate	44 parts
Potassium Sulphate	2 "
Sodium Chloride	18 "
Sodium Bicarbonate	36 "

Artificial carlsbad water contains about 70 parts of this salt to 1000 c. c. of water.

EFFERVESCENT PREPARATIONS

These preparations of the salts form gas (effervesce), when dissolved in water.

Seidlitz Powder
(Pulvis Effervescens Compositus)

This is made up in two powders:

1. The powder wrapped up in **blue paper** contains:

Sodium Bicarbonate	2.5 gms. grs. xl
Rochelle Salts (Potassium and Sodium Tartarate)	8.0 gms. ʒii

2. The powder wrapped up in white paper contains:

Tartaric Acid	1.5 gms. grs. xxv

A seidlitz powder should always be administered at the bedside. Each powder should be dissolved in half a glass of water, the two solutions mixed and the mixture given to the patient.

The combination of the tartaric acid and sodium bicarbonate forms carbon dioxide gas, which causes the effervescence. Seidlitz powder is often given to distend the stomach, for diagnostic purposes.

Solution of Citrate of Magnesia
(Liquor Magnesii Citratis) dose 150.0–360.0 c.c. ℥v–xii

This is a solution of magnesium citrate and citric acid, to which potassium bicarbonate is added. It is usually kept in tightly closed bottles, and effervesces when it is poured in a glass.

Effervescent Magnesium Sulphate 15.0–30.0 gms. ℥$\frac{1}{2}$–i
(Magnesii Sulphas Effervescens)

This contains epsom salt, sodium bicarbonate, tartaric and citric acids. The mixture effervesces when mixed with water.

Effervescent Sodium Phosphate 8.0–15.0 gms. ʒii–℥$\frac{1}{2}$
(Sodii Phosphas Effervescens)

This contains sodium phosphate, sodium bicarbonate, tartaric and citric acids. The mixture effervesces when dissolved in water.

Effervescent Lithium Citrate 4.0–8.0 gms. ʒi–ii
(Lithii Citras Effervescens)

This contains lithium citrate or lithium carbonate, sodium bicarbonate and citric acid.

All the effervescent preparations, if not already in solution, should be given in a tumblerful of water.

Many natural mineral waters are used as cathartics. The following are the preparations commonly used:

Hunyadi Water (not official)

Carlsbad Water

This contains magnesium and sodium sulphate, and other salts.

Apenta Water (not official)

This consists mainly of sodium and magnesium sulphate with small quantities of sodium chloride and Sodium bicarbonate.

Pluto Water (not official)

This is obtained from the French Lick springs in Indiana, and consists mainly of sodium and magnesium sulphates with small quantities of sodium chloride, calcium, magnesium and iron salts.

DRASTIC CATHARTICS

Drastic cathartics are drugs which cause frequent fluid movements of the bowels, accompanied by severe griping pains.

ACTION

The drugs used as drastic cathartics act principally on the small intestine. They increase the secretions of the intestinal mucous membrane and the contractions of the intestinal muscles, thus causing frequent copious fluid stools accompanied by griping. The drastic cathartics withdraw fluid from the tissues into the intestines, and thus tend to relieve oedema and ascites. The copious fluid stools frequently cause severe collapse. Drastic cathartics should therefore not be given to very young or to very old patients. In pregnant women they may induce abortion. When several drastic cathartics are given together they are not so apt to cause such violent action as when given alone.

Poisonous Effects

In large doses, most of the drastic cathartics are violent poisons.

The symptoms which such doses cause are nausea, vomiting, abdominal pain and profuse diarrhoea. The stools contain blood and flakes of the lining membrane of the intestines, which is usually very severely inflamed by large doses. In spots, the lining membrane of the intestine may even be destroyed by such doses.

As a result of these symptoms, there is usually severe collapse: the skin is pale, moist and cold, the breathing is slow and shallow, the pulse is rapid, thready and weak, the pupils are widely dilated, and the patient finally goes into coma and may die.

CROTON OIL (OLEUM TIGLII)

Croton oil is a fixed oil (an oil which does not evaporate), pressed out from the seeds of the **Croton tiglium,** a shrub growing in Hindostan and other parts of Southern Asia. Its active principle is an acid, **crotonoleic acid.**

ACTION

Croton oil acts principally on the small intestine; producing in one or two hours after it is given, frequent large fluid stools with severe griping pains. The violent movements of the bowels continue for about twelve to fifteen hours, and each stool is accompanied by severe griping, so that the patient soon becomes exhausted.

Mode of Action

Croton oil acts like castor oil. Crotonoleic acid is formed by the digestive juices, and causes the bowel movements. Some of the crotonoleic acid is absorbed into the blood, and is excreted by all the secretions.

Preparations

Croton Oil (Oleum Tiglii)	0.06–0.12 c.c.	m. i–ii

Administration

Croton oil is given principally in cases where the patient is unable, or unwilling to swallow. In cases of apoplexy for,

instance, when the patient is unconscious; or in an attack of mania, when the patient is so excited, that he is unwilling to swallow medicine.

In such cases, one or two drops, either of the pure croton oil, or the oil dissolved in glycerin or olive oil, are placed on the back of the tongue with a spoon. The oil may also be given on a piece of sugar, or on a few bread crumbs.

Croton oil is occasionally applied to the skin, to produce redness, and thereby to relieve congestion of deeper organs, (counterirritant action). A few drops of croton oil are poured on a piece of flannel, and rubbed on the skin. It may also be added to olive oil, or to a liniment, and applied by rubbing on the skin.

JALAP—JALAPA

Jalap is the root of the **Ipomoea jalapa,** a twining vine of Mexico. Its active principle is a resinous substance, **jalapin.**

It is one of the most commonly used drastic cathartics.

Preparations

Resin of Jalap (**Resina Jalapae**)	0.1–0.3 gm.	grs. ii–v
Compound Jalap Powder (**Pulvis Jalapae Compositus**)	1.0–4.0 gms.	grs. xv–℥i

This contains jalap and cream of tartar.

ELATERINE

Elaterium is the juice obtained from the fruit of **Ecballium elaterium,** or **squirting cucumber,** of Greece and Western Asia. This fruit contains an inner sac which is filled with juice and contains the seeds. The dried juice is elaterium, from which is obtained **elaterine,** the active principle, which is the resinous substance used.

Locally: Elaterine is very injurious to the skin. It frequently causes inflammation and ulcers, on the fingers of those who constantly handle the drug.

Internally: It is the best drug to produce fluid stools and is therefore used to remove fluid from the tissues in the cases of oedema and ascites. It is also used to reduce blood pressure in cases of apoplexy.

Elaterine is frequently given hypodermically.

Preparations

Elaterine (**Elaterinum**)	0.001–0.005 gm.	gr. $\frac{1}{60}$–$\frac{1}{10}$
Triturate of Elaterine (**Trituratio Elaterini**)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i

Containing 1 part of elaterine, to 9 parts of sugar of milk.

The following drastic cathartics are seldom given alone. They are usually combined with other cathartics.

COLOCYNTH (COLOCYNTHIS)

Colocynth is the pulp of the bitter cucumber or **Citrullus colocynthis**, which grows on vines in Egypt, Syria, South Africa, Turkey and Japan. Its active principle is **colocynthin**, a resinous substance.

Preparations

Extract of Colocynth (**Extractum Colocynthidis**)	0.015–0.03 gm.	gr. $\frac{1}{4}$–$\frac{1}{2}$
Compound Extract of Colocynth (**Extractum Colocynthidis Compositum**)	0.2–1.0 gm.	grs. iii–xv

Containing colocynth, aloes, scammony and cardamom.

Colocynthin (active principle) (Not official)	0.005-0.001 gm.	grs. $\frac{1}{12}$–$\frac{1}{6}$

GAMBOGE (GAMBOGIA)

Gamboge is a gum resin obtained from the **Garcinia hanburii**, a tree of Siam. The leaves and young branches of the tree are broken off, and the juice, which is the gum resin, is caught from the broken twigs in vessels and dried.

Gamboge is one of the most violent drastic purgatives and may cause very severe collapse.

Preparations

Gamboge (Gambogia)	0.1–0.6 gm.	gr. ii–x

SCAMMONY (SCAMMONIUM)

Scammony is the dried milky juice (resin), obtained from the root of the **Convolvulus scammonia,** a vine growing in Syria. Its active principle is jalapin, a resinous substance.

Scammony is used principally as a drastic cathartic.

Preparations

Resin of Scammony (Resina Scammoniae)	0.2–0.5 gm.	grs. iii–viii

COMPOUND PREPARATIONS OF DRASTIC PURGATIVES

Compound Cathartic Pills

(Pilulae Catharticae Compositae)

This is very frequently used. Each pill consists of:

Compound Extract of Colocynth	0.08 gm.	gr. $1\frac{1}{3}$
Calomel	0.06 gm.	gr. i
Resin of Jalap	0.2 gm.	gr. $\frac{1}{3}$
Gamboge	0.015 gm.	gr. $\frac{1}{4}$

1 pill is given for a purgative, 3 pills for a drastic effect.

Vegetable Cathartic Pills

(Pilulae Cartharticae Vegetabiles)

Compound Extract of Colocynth	0.06 gm.	gr. i
Extract of Hyoscyamus	0.03 gm.	gr. $\frac{1}{2}$
Resin of Jalap	0.02 gm.	gr. $\frac{1}{3}$
Extract of Leptandra	0.015 gm.	gr. $\frac{1}{4}$
Resin of Podophyllum	0.015 gm.	gr. $\frac{1}{4}$

and about m. i of oil of peppermint for every hundred pills.

The peppermint and the hyoscyamus lessen the griping.

ENEMATA

Enemata are fluids which are injected into the rectum. They are of two kinds: **cathartic** and **nutritive.**

Cathartic Enemata

Cathartic enemata are given to move the bowels. They usually act by distending the large intestine, so that peristalsis is set up. The contents of the intestines are expelled and frequent movements of the bowels result.

The following are the substances commonly used in enemata:

Plain Water
Salt Solution
Soap Suds
and various Cathartics.

An excellent combination of cathartics which is given as an enema consists of:

Glycerine	120.0 gms.	℥ iv
Magnesium Sulphate	120.0 gms.	℥ iv
Ox gall	8.0 gms.	ʒ ii
Turpentine	8.0 gms.	ʒ ii

The turpentine is particularly valuable because it helps to expel gas. Another good combination consists of milk and molasses, which is especially efficient. The sugar and milk form gas which distends the intestine, causing frequent copious movements of the bowels. Starch is frequently added to lessen the irritation of the rectum.

Nutritive Enemata

Nutritive enemata are usually given to nourish the patient, when food cannot be taken by the mouth. They usually consist of milk, eggs, various meat juices, broths, or special prepared substances. The substances should be completely peptonized. They should be given very slowly, best by the **Rectoclysis** or **Murphy Method.**

ABSORBENT

CHARCOAL (CARBO LIGNI)

Charcoal is made from wood or bones. It readily absorbs gases and is therefore used to remove gas from the intestines.

It is best given in capsules, since it soon loses its efficiency when dissolved in a fluid.

SUMMARY OF PRINCIPAL CATHARTICS

Cathartics Arranged According to Site and Rapidity of Action

Group	Acting on Duodenum	Rapidity of Action	Acting on Small Intestine	Rapidity of Action	Acting on Large Intestine	Rapidity of Action	Acting on Entire Intestine	Rapidity of Action
		Hrs.		*Hrs.*		*Hrs.*		*Hrs.*
Laxatives			Olive Oil	8–12	Cascara	8–12	Mineral Oil	8–12
					Agar Agar	8–12		
Purgatives	Calomel	2–8	Castor Oil	2–8	Rhubarb	8–12	Licorice Powder	8–12
	Mercury preparations	2–8			Aloes	8–12	Physostigmine	½–4
	Podophyllum	8–12			Senna	8–12	Saline Cathartics	
					Phenolphthalein	8–12	(when dilute)	1–2
					A.B.andS. Pill (Lapactic pill)	8–12	(when concentrated)	6–12
Drastic Cathartics			Jalap	2–4				
			Elaterine	½–3				
			Colocynth	2–4				
			Gamboge	2–4			Croton Oil	½–2
			Scammony	2–4				
			Compound Cathartic Pill	2–4				

Note: The cathartics that act slowly are best given at night.

SUMMARY OF PRINCIPAL CATHARTICS (Continued)

Time of Administration

Group	At night	Before breakfast	Between meals	Special Methods of Administration
Laxatives	Cascara Sulphur Agar Agar		Olive oil	Mineral oil Liquid Petrolatum (2 hrs. after meals)
Purgatives	Podophyllum Penolphthalein Compound Licorice Powder	Saline Purgatives	Calomel Mercury preparations Castor oil Rhubarb Aloes Senna A. B. and S. pill (Lapactic pill)	Physostigmine (hypodermically)
Drastic Cathartics			Croton oil Jalap Elaterine Colocynth Gamboge Scammony Compound Cathartic pill	Elaterine (hypodermically)

Types of Action

Pharmacological Action				Mechanical Action
Salts, metals and other chemical substances	*Oils*	*Anthracene substances (coal tar derivatives)*	*Resins*	
Calomel Mercury preparations Phenolphthalein Saline Cathartics (Salt action)	Olive oil Castor oil Croton oil	Cascara Frangula Rhubarb Aloes Senna	Podophyllin Jalap Elaterine Colocynth Gamboge Scammony	Liquid Petrolatum or mineral oil Agar Agar

CHAPTER X

ANTHELMINTICS

Anthelmintics are drugs which are principally used to destroy or expel intestinal worms. The drugs which destroy these worms are often called **vermicides,** and those which expel them, **vermifuges.** This difference in their action really depends, however, upon the amount of drug given, and how soon afterwards the bowels are moved. Thus, a large dose of one of the anthelmintics, if it remains in the intestine, will destroy, while a smaller dose will merely expel the worm.

With the exception of pelletierine, which has a specific action on tape worms, most of the anthelmintics do not affect the worms selectively.

All the anthelmintics are poisonous both to the worm and to the patient, but they are very slowly absorbed, so that their poisonous action is manifested mainly on the worm. Occasionally, if they are not followed by a cathartic, the drugs may be absorbed, and poisonous symptoms then result.

The anthelmintics are best classified according to the particular worm for which they are used.

The following are the most common worms which often occur in the intestines:

1. **Tape Worms, or Taeniae.**
2. **Round Worms, or Lumbrici.**
3. **Thread Worms, Seat Worms or Ascarides.**
4. **Hook Worms, or Uncinariae.**

The diagnosis of the form of worm is usually made by finding the characteristic eggs in the stools.

Administration

In giving any of the anthelmintics, it is important that the following routine measures be carefully carried out:

1. The patient should be given a very light diet, a day or

two before the drug is administered, or better still, no food should be given for twenty-four hours before.

2. The bowels should be thoroughly moved with a light laxative, the day before administration.

3. The drug should best be given early in the morning on an empty stomach.

4. About four to eight hours after the administration, a brisk cathartic such as calomel or castor oil, should be given, to expel the worm. Occasionally a cathartic like calomel is given together with the drug.

No food should be given until the bowels have moved.

TAENICIDES

Taenicides are drugs which destroy or remove tape worms.

Tape worms are long flat worms which consist of many segments. They often inhabit the intestine as a result of eating meat or pork infected with their eggs.

MALE FERN (ASPIDIUM FILIX MAS)

Male fern or filix mas is obtained from the underground stems of the **Dryopteris filix mas** and of **Dryopteris marginalis,** European ferns.

The active principles of these plants are a number of neutral and acid substances such as **aspidin. Filicic acid** was formerly supposed to be the active principle.

ACTION

When taken internally, male fern has a very unpleasant, nauseous taste, and **it destroys tape worms and hook worms.**

Poisonous Effects

In some individuals, if large doses of the drug are given, it may be absorbed and cause:

1. Abdominal pain.
2. Nausea, vomiting and diarrhoea.
3. Muscular twitchings.
4. Convulsions, collapse, coma, and death.

Administration

The oleoresin or liquid extract is usually given, either in pills, capsules or as a suspension in mucilage.

Preparations

Oleoresin of Aspidium (**Oleoresina Aspidii**)	2.0–8.0 c.c.	ʒ½–ii

New and Non-official Preparations

Filicic Acid Amorphous (**Acidum Filicicum Amorphum**)	0.5–1.0 gm.	grs. viii–xv
Filmaron	10 c.c.	ʒii½

This is a substance obtained from an ethereal extract of aspidium. It is said to be safer than aspidium.

This is a 10% solution of filmaron in castor oil.

CUSSO

Cusso, kousso or brayera, are the female flowers of **Hagenia abyssinica** or **Brayera anthelmintica,** an Abyssinian tree. Its active principle is a neutral resin, **kosotoxin,** but it also contains tannic acid, a volatile oil and other substances.

ACTION

Cusso has a bitter taste and contracts mucous membranes. Its principal effect is to destroy tape worms.

Large doses occasionally cause nausea, vomiting, diarrhoea and rarely, collapse with an irregular pulse.

Preparations

Cusso is usually given in doses of 15.0 gms. (ʒ½) of the powdered flowers in water as a suspension.

Fluidextract of Cusso (not official) (**Fluidextractum Cusso**)	4.0–16.0 c.c.	ʒi–iv

No cathartic is required after cusso, though the usual preparatory methods should be carried out.

GRANATUM (POMEGRANATE)

Granatum is the bark of the stem and root of **Punica granatum** or pomegranate. Its active principles are the alkaloids **pelletierine** or **punicine,** and **isopunicine;** and it also contains a large amount of tannic acid.

ACTION

Granatum and its alkaloids, have a specific destructive action on tape worms. It has a very unpleasant taste and is not a safe drug to use.

Poisonous Effects

Overdoses of pelletierine or granatum, paralyze the nerve endings of the muscles, causing effects like those of curara poisoning.

Symptoms

1. Mental dullness and confusion of ideas.
2. Dizziness.
3. Great weakness of the limbs, even paralyses.
4. Dimness of vision.
5. Occasionally nausea, abdominal pain, perhaps vomiting and tremors of the muscles of the legs.

Administration

Granatum is usually given as a decoction made from about 30.0–60.0 gms. (℥i–ii) of fresh bark, in about 250.0 c.c. (½ pt.) of water. The drug is then given in two parts at intervals of an hour each, and the last dose should be followed in a half to two hours by a cathartic.

Preparations

Fluidextract of Pomegranate (Fluidextractum Granati)	2.0 c.c.	m. xxx
Pelletierine Tannate (Pelletierinae Tannas)	0.25 gm.	grs. iv

This is a mixture of all the alkaloids of pomegranate **bark.**

PEPO (PUMPKIN SEED)

Pepo is the ripe seed of **Cucurbita pepo** or the ordinary pumpkin. Its active principle is a fixed oil and a resin.

ACTION

Pumpkin seeds are a very efficient and harmless remedy for tape worms.

Administration

The patient should fast the day before the drug is to be given, and the following morning, about two to four ounces of the seeds, beaten up in an emulsion of sugar and water, or honey, should be given. Occasionally, 15.0 gms. (℥ss) of the expressed oil is given. It should always be followed by a cathartic several hours later.

Preparations

Pepo or **Pumpkin Seeds**	30.0–120.0 gms.	℥i–iv

KAMALA

Kamala is a reddish brown powder consisting of the minute glands and hairs from the capsules of **Mallotus philippensis,** an East Indian shrub. Its active principles are two resinoid substances, **kamalin** and **rottlerin.**

ACTION

Kamala destroys the tape worms and causes profuse diarrhoea so that no cathartic is necessary after its use.

Preparations

About 4.0–8.0 gms. (℥i–ii) of the powder is given in syrup, and repeated in two hours if the bowels do not move. **A tincture of kamala** is also occasionally given.

TURPENTINE

Turpentine destroys tape worms and round worms. It is given in doses of 30.0 gms. (℥i) with twice its amount of

castor oil. It is also given in very small doses, together with other anthelmintics. It is very apt to cause poisonous symptoms and is therefore not frequently used.

LUMBRICIDES

Lumbricides are drugs which destroy round worms. Round worms are small cylindrical worms which are often found in the small intestine of children.

SANTONICA (LEVANT WORM SEED)

Santonica or levant worm seed is the dry unopened flower heads of the **Artemisia pauciflora**, a plant growing in Asia Minor. Its active principle is a crystalline substance called **santonin**, though it also contains a similar substance called artemisin and a volatile oil, cineol.

ACTION

Santonin has a bitter taste and is partly dissolved in the stomach. Here some of it is absorbed into the blood. Most of the santonin then passes out into the small intestine, where **it destroys round worms, or ascaris lumbricoides.**

Action after Absorption

The absorption of some of the santonin, causes, in many cases, a very characteristic and peculiar disturbance of vision known as **xanthopsia**, or "**yellow vision.**"

At first all objects seem to have a blue color, but this effect lasts for a very short time, and is soon followed by a condition where **all objects seem to have a yellow tint**; thus, blue seems green; and violet cannot be seen at all. This condition lasts for several hours and is probably due to a direct poisonous effect on the retina of the eye. Occasionally there are also disturbances of the sense of taste, smell, and hearing.

Santonin is excreted by the urine, to which it gives a characteristic yellow or reddish color.

Poisonous Effects

Overdoses of santonin not infrequently cause poisonous symptoms, especially in children.

Symptoms

1. "Yellow vision."
2. Twitchings of the muscles of the head.
3. Rolling of the eyes, and grinding of the teeth.
4. Various movements of the head, forward and backward, and from side to side. These symptoms are soon followed by:
5. Convulsions.
6. Slow, irregular breathing, especially during the convulsions.
7. Collapse (slow, weak pulse, moist, cold skin, dilated pupils, etc.).
8. Occasionally nausea and vomiting, or loss of speech (aphasia), occur.

Treatment

The stomach should be washed out; emetics and cathartics are given. The convulsions are treated with chloroform or ether.

Preparations

Santonin, the active principle, is the drug which is principally used.

Santonin (Santoninum) 0.03–0.3 gm. grs. $\frac{1}{2}$–v

For a child 2 years old 0.015 gm. (gr. $\frac{1}{4}$) should be given.

Troches of Santonin (Trochisci Santoninae) 1–5

Each contains 0.03 gm. (gr. $\frac{1}{2}$) of santonin.

For a child, only 1 should be given.

SPIGELIA (PINK ROOT)

Spigelia or pink root is the root of the Spigelia marilandica, or carolina pink, a plant growing in the southern United States.

ACTION

Spigelia is used to remove round worms. As it does not destroy the worm, it must be followed by a brisk cathartic.

Poisonous Effects

Overdoses of spigelia have occasionally produced the following symptoms, especially in children:

1. Dry, flushed skin.
2. Puffiness and swelling of the face.
3. Rapid pulse, delirium and stupor.
4. Dimness of vision or temporary blindness.

Preparations

Fluidextract of Spigelia (Fluidextractum Spigeliae)	4.0–8.0 c.c.	ʒi–ii

For a child, 0.6 c.c. (m. x) is given on a piece of sugar, often together with senna.

AZEDARACH

Azedarach is the bark of the root of **Melia azedarach,** or the pride of China, an Eastern plant.

It is used in the South as a remedy for round worms. It is usually given as a decoction, made from ʒii of the plant to a half pint of water, of which 15.0 c.c. or ʒss is given every two hours. It is said to produce the same poisonous effects as spigelia.

CHENOPODIUM (not official)

Chenopodium or American worm seed, is the fruit of the **Chenopodium ambrosioides,** or Jerusalem oak, an American plant. Its active principle is a volatile oil, which has an extremely unpleasant odor.

ACTION

Chenopodium is used principally as a remedy for round worms. It is also used for the treatment of pin worms and

tape worms. It is now being successfully used as a remedy for hookworm disease.

Administration

Chenopodium is very constipating. Consequently a dose of castor oil or a saline purgative should be given in the morning of the day before giving chenopodium. The patient should be kept on a liquid diet all that day. The following morning another dose of castor oil or a saline purgative is given. An hour later a capsule containing 0.3–0.6 c.c. (mv–x) of an emulsion of chenopodium is given and the dose is repeated two and four hours later. Three hours after the last dose a dose of castor oil containing about 1.0 to 2.0 c.c. of chloroform water is given. No food is given for the rest of the day. The treatment is repeated every week until the patient is cured.

Poisonous Effects

Poisoning from chenopodium is not uncommon. The nurse should watch for persistent drowsiness which is usually the first symptom.

Symptoms

1. Drowsiness.
2. Nausea and vomiting.
3. Diarrhoea with stools containing blood and mucus.
4. Mental depression.
5. Great weakness.
6. Collapse.
7. Convulsions and paralyses.

Preparations

Oil of Chenopodium (**Oleum Chenopodii**)	0.2–0.3 c.c.	m. iii–v

It is usually given on sugar or in an emulsion.

Senna and **Calomel** are also frequently used to remove round worms.

DRUGS WHICH DESTROY THREAD WORMS

Thread worms are small cylindrical worms which often inhabit the large intestine. The patients suffering from these

worms are usually treated by enemata of the following substances:

1. **Quassia**
2. **Alum**
3. **Sodium Chloride**
4. **Tannic Acid**
5. **Calumba**
6. **Lime Water**
7. **Vinegar**

DRUGS WHICH DESTROY HOOK WORMS

Hook worms, **uncinaria americana,** or **anchylostoma duodenale,** are small cylindrical worms which frequently inhabit the small intestine or duodenum.

Many people in the Southern United States, Switzerland and Egypt suffer from these worms, which cause a very severe form of anaemia.

The following drugs are used to destroy hook worms:

THYMOL

Thymol is a stearoptene resembling carbolic acid chemically, which is obtained by evaporating the oil of thyme. This is a volatile oil obtained from **Thymus vulgaris** and other similar herbs which are found in most countries.

ACTION

Thymol produces the following effects:

1. It acts as an antiseptic on the skin and mucous membranes.

2. It checks the growth of bacteria in the intestines; thereby lessening fermentation.

3. It is said to lower temperature, and it produces perspiration.

It is used principally as an antiseptic gargle and mouth wash and as an intestinal antiseptic.

Thymol is extensively used as a remedy for Hookworm disease for which it is almost a specific. Hookworm disease is a very prevalent disease in the South. It is due to the presence of hookworms in the intestinal tract. The disease is characterized by severe anaemia, laziness, mental dull-

ness, retardation of growth and perverted appetites (loss of appetite, the eating of chalk, hair, or clay). The Chalk Eaters in the South suffer from Hookworm Disease.

The parasite usually enters the body from the ground, through the skin between the toes or the palms of the feet. At the site of entry they form characteristic pustules the so-called "ground itch" pustules.

Thymol is also used as a remedy for Trichinosis, a disease produced by a parasite, the Trichina Spiralis lodging in the muscles. The parasite enters the body from the intestinal tract. In this disease it is given hypodermically in doses of 0.12–0.2 gm. (grs. ii–iii) in olive oil every day.

Administration

The following method of giving thymol is the one adopted by the United States Public Health Service in its extensive campaign for the eradication of Hookworm Disease in the South.

1. Give a dose of Magnesium Sulphate the night before.

2. At 6 A. M. the following morning give 1.0–2.0 gm. (grs. xv–xxx) in 0.3 gm. (grs. v) capsules mixed with milk sugar or sodium bicarbonate.

3. At 10 A. M. another dose of Magnesium sulphate should be given.

The dose for children is half the adult dose given in the same manner.

Poisonous Effects

Poisoning from Thymol is not uncommon. The symptoms are principally ringing in the ear, nausea, vomiting, and collapse.

Calomel, oil of chenopodium naphthol and magnesium sulphate are also frequently used to destroy hook worms.

PART III—DRUGS USED PRINCIPALLY FOR THEIR EFFECTS UPON THE BLOOD AND CIRCULATION

CHAPTER XI

HAEMATINICS

BLOOD STIMULANTS OR TONICS

Physiology of the Blood

The blood is a thick red fluid, which supplies all the various tissues and organs of the body with nourishment and oxygen. It also takes away all the waste products, resulting from their various activities. These waste products are brought to the lungs, kidneys and intestines where they are excreted.

The blood consists of a straw colored fluid (plasma) in which float small round cells called corpuscles. The corpuscles are of two kinds: **red corpuscles** and **white corpuscles, or lecucocytes.**

The red corpuscles contain a protein substance, haemoglobin, which contains iron and which imparts the red color to them.

This haemoglobin of the red corpuscles takes up oxygen from the air in the lungs; and brings it to the various organs of the body where it is used up by their various activities.

The white corpuscles, together with the plasma act as cleansers of the blood. They destroy bacteria in the blood and help to neutralize their poisons by the formation of antidotes. The white corpuscles then bring these dead bacteria to the kidneys, intestines and other organs for excretion.

Formation of Blood

The plasma is formed from the digested food, which passes through the lining membrane of the intestines into the blood vessels. Some of the plasma formed from the

digested food first enters the lymphatic vessels, from which it finally reaches the blood stream.

The red and white corpuscles are formed in the bone marrow and spleen. The haemoglobin is formed in the liver and spleen.

Effects of Drugs on the Blood

Drugs affect the blood in two ways:

1. **They may increase the amount,** or **improve the quality,** or both (**stimulation.**)

2. They may **lessen the amount,** or **deteriorate the quality** of the corpuscles and plasma (**depression**).

Stimulation of the blood occurs:

a. When drugs *increase the amount* of plasma and the number of red or white corpuscles, or both.

b. When they *improve the quality* of the corpuscles, for example, by increasing the amount of haemoglobin.

Depression of the blood occurs:

a. When drugs *lessen the amount* of blood by withdrawing some of the fluids.

b. When they reduce *the number of corpuscles.*

c. When they *combine with the haemoglobin* so that it is unable to take up oxygen from the air in the lungs.

In this chapter we shall consider only those substances which improve the condition of the blood (blood stimulants).

NORMAL SALT SOLUTION

In cases where a patient has lost a considerable amount of blood, life may be endangered, because there is not sufficient blood in the body for the heart to pump. The heart beats then become very weak, slow or rapid, and the pulse is weak, slow and soft.

To keep the heart beating, until new blood can be formed, to make up for the amount lost, salt solution of a definite strength is often injected into a vein, or into the muscles. This keeps the heart beating, thus maintaining the circulation of the blood.

The percentage of salt (sodium chloride) used, is a 0.9% solution, or 9 parts of salt to a thousand parts of water. Such a solution is called a **normal salt solution.**

A salt solution of this strength does not destroy the red corpuscles of the blood and is called an **isotonic solution.** If a fluid weaker than this percentage is injected into the blood, the red corpuscles are destroyed. Such a solution is called a **hypotonic** or **anisotonic solution.** If a stronger percentage of salt solution than 0.9% is used, the blood corpuscles are shrunk (crenated). Such a solution is called **a hypertonic solution.**

The strengths usually given for normal salt solution vary from 0.6–0.9%. Different percentages are often used for different purposes. We may readily understand the variation in the strengths usually given for normal salt solution, by reviewing the essential facts regarding the salts of the blood.

The blood contains various salts. Of these salts 0.6% is sodium chloride or table salt; and the others, which are principally potassium chloride and calcium chloride, comprise 0.3%. A solution which contains these salts in the percentages in which they occur in the blood best maintains the integrity of the corpuscles. Such a solution is called Ringer's solution, and is frequently used in laboratory work. It is now coming into use in practical medicine. The integrity of the corpuscles, however, may also be maintained by any salt solution which contains 0.9% of salt. For practical purposes we therefore use such a solution of sodium chloride or ordinary table salt. This may be prepared by adding 8.0 gms. or ʒii of sodium chloride to a quart of sterile water, thus preparing a normal salt solution.

Frequently we use a 0.6% solution of salt or sodium chloride, especially when other medicines are to be added to the solution which may tend to increase its isotonic power (the power of maintaining the integrity of the corpuscles). Since such a salt solution contains the exact physiological quantity of sodium chloride as the blood, it is better to call it **a physiological salt solution.**

In preparing normal salt solutions it is better to use

ordinary table salt and plain undistilled sterile water. Both contain minute quantities of calcium which tends to prevent the undesirable effects that occasionally result from the sodium.

RINGER'S SOLUTION

Ringer's solution is a solution containing the exact salts of the blood in the same percentages as they occur in the blood. It is used in the same way as normal salt solution but it is preferable to it because it contains all the salts found in the blood as follows:

Calcium chloride	0.02%
Potassium chloride	0.02%
Sodium chloride	0.9 %
Sodium bicarbonate	0.01%

Ringer's tablets are tablets containing the salts found in the blood which make a Ringer's solution when dissolved in a definite quantity of water. The following is the formula of the Ringer's tablet:

Calcium chloride	0.05 gm.
Potassium chloride	0.05 gm.
Sodium chloride	2.25 gms.
Sodium bicarbonate	0.025 gm.

Another tablet contains **Dextrose** 0.25 gm. in addition

When one of these tablets is dissolved in 250 c.c. of water it forms a Ringer's solution.

Methods of Administration

1. Intravenous Infusion: This is the quickest method for getting normal salt solution into blood.

The solution is injected into the median basilic, or into the median cephalic vein of the forearm, by means of a special apparatus which is held about two feet above the patient. The salt solution is allowed to run through a long rubber

tube and cannula, the cannula being inserted into the vein in a direction toward the heart.

2. Hypodermoclysis: This is a slower method of getting normal salt solution into the blood.

The solution is allowed to run in underneath the breasts, or into the thighs, through a large needle which is inserted into these regions. The needle is attached to a rubber tube connected with a bottle which contains the salt solution. The fluid is absorbed into the blood from the tissues underneath the breasts, or from the thighs.

3. Rectoclysis, or **Murphy Method:** This method consists in allowing the solution to run into the rectum, drop by drop, through a catheter. This is attached by a long rubber tube, to a receptacle containing salt solution, which is held a few feet above the level of the bed. When the solution enters the rectum it is absorbed into the blood through the rectal mucous membrane.

Effects

After an intravenous infusion, or a hypodermoclysis of salt solution, the heart usually beats stronger and faster, the pulse is stronger, faster and more bounding in quality; and the blood pressure is increased. The patient breathes faster and deeper and feels brighter.

Transfusion

Occasionally, when a patient has lost a great deal of blood, blood from another individual is injected into one of his veins. This is done by sewing an artery of the healthy individual to the vein of the patient; and allowing the blood from the donor to flow into the patient's veins, for about an hour. The effects produced are the same as those following an infusion, but they are more lasting.

Recently a method of transfusion has been devised whereby blood is withdrawn from one of the veins of a healthy individual, and sodium citrate is added to it to prevent its clotting. This prepared blood is then injected into one of the veins of the patient.

SODIUM CITRATE

Sodium citrate is now extensively used in preparing blood for transfusion. It prevents the clotting of the blood by combining chemically with the calcium salts. About 10 c.c. of a 2% solution is added to every 100 c.c. of blood taken from the donor. It also comes in sterile glass ampoules each containing 10 c.c. of a 2% solution.

SUBSTANCES USED TO INCREASE BLOOD CLOTTING

Physiology of Clotting of the Blood

Blood has the peculiar property of changing from a liquid to a gelatinous solid state when it is removed from the blood vessels. This property of clotting prevents a serious loss of blood from haemorrhage. The formation of a clot in the opening of the bleeding vessel acts as a plug to prevent further loss of blood. If blood is allowed to stand for a short time after it has clotted it separates into two parts: a clear straw colored liquid, at the bottom of which is the dark red gelatinous clot.

Microscopic examination of the solid part of the clot reveals that it consists of a mass of red and white blood cells held together by a network of fibrin.

Three factors are necessary to enable blood to clot: **calcium salts, fibrin ferment** and contact with any substance other than the walls of the blood vessels. The fibrin network exists in the blood dissolved in the serum. In this dissolved state it is called **fibrinogen.** This fibrinogen is changed to **fibrin** by the action of a ferment **thrombin.** This ferment exists in the blood in the form of prothrombin which is changed into thrombin by the action of calcium salts and a substance called **thrombokinase** or **thromboplastin.** Thromboplastin is only formed during bleeding from the injured tissue, from the blood cells and from the blood platelets.

Fibrin Ferments and Thromboplastic substances

The following group of substances are used to aid the clotting of blood. All the tissues which form thromboplastin contain a fatty like substance (lipoid) called kephalin which is found in brain tissue. Consequently various preparations have been made from a number of tissues containing kephalin which therefore contain thromboplastin and have the property of clotting blood.

Uses

Thromboplastin or substances containing it are applied locally on gauze sponges to bleeding points to check hæmorrhage. They are also used hypodermically or intravenously in 0.1 to 0.2% solutions in normal salt solution to check internal hæmorrhage.

Thromboplastin preparations should not be used in diseases where the coagulation of blood or the formation of clots is detrimental as in heart disease, aneurysm, etc.

Preparations

Kephalin

This is a substance prepared from chopped up ox brains which contains thromboplastic substances.

Solution of Brain Extract

This is an extract of cattle brains containing thromboplastic substances. It comes in ampoules each containing 25 c.c.

Thromboplastin solution

This is the same as solution of brain extract.

Coagulen (Ciba)

This is an extract prepared from blood platelets containing thromboplastic substances.

The preparations are usually yellowish granular powders which dissolve readily in water. They come in tablets of 0.5 gm. (grs. viii) with 0.46 sodium chloride. They also

comes in 1.5 c.c. ampoules each containing a 3% solution, for hypodermic use and in 20 c.c. solutions for local use.

The solutions must always be fresh. They are prepared by dissolving in normal salt solution and boiling for three minutes.

Calcium salts in large doses are usually given to aid the clotting of blood (see page 125).

IRON (FERRUM)

Iron is a heavy metal; many of its preparations are used as drugs. Many food substances, such as meat, eggs and some vegetables, contain a great deal of iron. In the body, iron is found principally in the haemoglobin of the blood; about one part of iron to 230 parts of corpuscles.

ACTION

Local Action: On the skin, iron causes no effect, but if it is applied to a bleeding surface, it stops the bleeding, by precipitating (hardening) the albumins of the blood, which then close up the bleeding vessel. **Mucous membranes** are contracted by preparations of iron (astringent action).

Internal Action

In the mouth: Iron has a distinct metallic taste, and shrinks the lining membrane of the mouth, making it feel dry. It also discolors the teeth, if used continually.

In the stomach: It contracts the lining membrane and occasionally causes nausea.

In the intestine: It contracts the lining membrane, checking the secretions, thereby producing constipation.

Action after Absorption

Part of the iron taken as food or as a medicine is slowly absorbed from the duodenum, the first part of the small intestine. It is then carried to the spleen, where it is stored up for future use; and to the liver, where it helps to form haemoglobin for the red blood corpuscles. If iron is taken

for any length of time, more haemoglobin is formed. The red blood corpuscles of the blood therefore contain more haemoglobin. They are then better able to take up more oxygen from the air in the lungs, and to supply the various organs and tissues of the body with more oxygen, which enables these organs to perform their work better. In exchange for the oxygen the corpuscles remove the carbon dioxide that results from the activities of the organs and tissues.

As a result of these effects, the contractions of the heart are improved; because the heart muscle itself is supplied with more oxygen. The patient is able to breathe deeper, and thus inhales more air (and therefore more oxygen) because the muscles for breathing, such as the diaphragm, are supplied with more oxygen. The breathing center in the brain, also sends more impulses for breathing; because it too, is supplied with better nourishment. The food is digested better; because the stomach, the salivary and pancreatic glands secrete more digestive juices, as a result of being supplied with better blood that contains more oxygen.

The muscles contract better, because they, too, are supplied with better blood, containing more oxygen.

The brain acts better, the patient is brighter, is more in harmony with his surroundings, because the brain is supplied with blood containing more oxygen.

All the organs of excretion, such as the kidneys, the lungs and skin, eliminate waste products better and quicker, because these organs are supplied with better blood and are able to do their work better.

Appearance of the Patient

As a result of the improved activity of all the organs of the body, the patient feels brighter, is more active, and more robust. He looks better, has a ruddier color, his appetite is better, and he digests his food better.

A drug which improves the general condition of the patient in this manner, is called a **tonic**.

The effects do not appear after a few doses, but result from continued administration of iron.

Excretion

Only part of the iron taken as a medicine, or in the food, is absorbed. The rest is excreted by the intestines, in the stools. On account of the large amount of iron present in the stools, the lining membrane of the intestines is contracted, and constipation results.

Uses

Iron is used principally in cases of **anaemia**, a condition in which the patient's blood is very poor. For example—when the patient has lost a great deal of blood, or when he is suffering from some chronic disease, such as tuberculosis or cancer. It is used with best results in a peculiar kind of anaemia, occurring in young girls, called **chlorosis.**

Poisonous Effects

In some cases, after continued use of iron for any length of time, it produces the following symptoms: frontal headache, loss of appetite, pain in the pit of the stomach, occasionally nausea and vomiting, colic and invariably constipation. Sometimes the skin becomes covered with very small pustules (acne).

The condition is relieved by stopping the iron, and giving cathartics.

Administration

In giving iron, the nurse should remember the following rules:

1. Iron should always be given after meals, well diluted, in an albuminous fluid such as milk.
2. To avoid discoloring the teeth, iron should always be given through a glass tube or a straw, so that the drug does not touch the teeth.
3. To avoid constipation, the bowels should be moved regularly with some cathartic, or a preparation of iron should be given which contains a cathartic.
4. If a gargle containing iron is given, the teeth should be brushed and the mouth then rinsed with salt water after each administration.

5. Silver spoons are stained by iron; they should never be used in giving any of the preparations. Strong ammonia water removes these stains.

6. Iron stains clothing, sheets, carpets, etc. Oxalic acid removes these stains.

Preparations

There are a great many preparations of iron, but only the most important ones follow:

There are several preparations of iron which are only used for their local effects or to check bleeding.

For internal use there are two kinds of preparations: inorganic and organic.

The inorganic preparations are metallic salts of iron.

The organic preparations are preparations of iron combined with various kinds of proteins, such as egg albumin.

The organic preparations do not contract mucous membranes as much as the inorganic ones; and are, therefore, not so apt to cause unpleasant symptoms after continued use.

Preparations for Local Use

Solution of Iron Subsulphate 0.2–0.6 c.c. m. iii–x
(Liquor Ferri Subsulphatis)
(Monsell's solution)

This preparation contains about 13% of iron.

Iron Chloride
(Ferri Chloridum)

This preparation is used in a 20% solution, or the pure crystals are allowed to take up moisture from the air by being exposed (deliquescent action), and are then used.

These two preparations are principally used to stop bleeding or to contract mucous membranes, either by local application, or in the mouth as a gargle.

Iron Sulphate 0.03–0.3 gm. grs. $\frac{1}{2}$–v
(Ferri Sulphas)
(Green vitriol)

This is seldom used internally, but it is used to contract

mucous membranes and check bleeding. It is also used as a disinfectant for privies or drains.

Preparations for Internal Use

Inorganic Preparations

Solids

Pills of Iron Carbonate 1–5 pills
(Pilulae Ferri Carbonatis)
(Blaud's pills)

These pills consist of iron sulphate, the carbonate of sodium or potassium, tragacanth, sugar and glycerin.

Each pill contains about 0.06 gm. (gr. i) of iron.

These pills should always be fresh. Old pills may pass through the intestines without causing any effects, or without being changed in any way.

Reduced Iron 0.06–0.12 gm. grs. i–ii
(Ferri Reductum)
(Quevenne's Iron)

This is a brown powder which is tasteless and does not contract mucous membranes. It is often given to children in candy.

Soluble Iron Phosphate 0.06–0.3 gm. grs. i–v
(Ferri Phosphas Solubilis)

Iron Citrate 0.06–0.3 gm. grs. i–v
(Ferri Citras)

Pills of Iron Iodide 1–3 pills
(Pilulae Ferri Iodidi)

Each pill contains 0.03 gm. (gr. $\frac{1}{2}$) of reduced iron, also iodine, acacia, licorice and balsam of tolu.

Iron and Strychnine Citrate 0.1–0.3 gm. grs. ii–v
(Ferri et Strychninae Citras)

This contains 1% of strychnine and 16% of iron.

Iron and Quinine Citrate 0.3–0.6 gm. grs. v–x
(Ferri et Quininae Citras)

This contains 12% of quinine and 15% of iron.

Solid Preparations Combined with Cathartics

Iron and Potassium Tartarate 0.3–0.6 gm. grs. v–x
(Ferri et Potassii Tartaras)

This contains 15% of iron.

Pills of Aloes and Iron 0.2–0.5 gm. grs. iii–viii
(Pilulae Aloes et Ferri)

This contains dried iron sulphate and aloes. The aloes overcomes the constipating effect. It is often used in cases of scanty menstruation or absence of menstruation (amenorrhoea), in chlorosis.

Fluid Preparations

Solution of Iron Tersulphate
(Liquor Ferri Tersulphatis)

This contains 10% of iron.

It is only used in making up other preparations, especially the antidote for arsenic.

Tincture of Iron Chloride 0.3–2.0 c.c. m. v–xxx
(Tinctura Ferri Chloridi)
(Muriated tincture of iron)

This is one of the best preparations of iron, and is very frequently used. It contains about 4% of iron in alcohol.

It is best given in milk or in glycerin, 3 parts of the preparation to one of glycerin, (to prevent constipation) or in egg albumin, to prevent its blackening the teeth.

Solution of Iron and Ammonium
Acetate 15.0–30.0 c.c. ℥ss–i
(Liquor Ferri et Ammonii Acetatis)
(Basham's mixture)

This preparation contains very little iron and must be freshly made. It consists of the tincture of iron chloride, dilute acetic acid, solution of ammonium acetate, elixir of orange, glycerin and water.

Syrup of Iodide of Iron 0.3–2.0 c.c. m. v–xxx
(Syrupus Ferri Iodidi) well diluted

This is an excellent preparation especially for children. It contains about 2% of iron.

Compound Iron Mixture 15.0–120.0 c.c. ℥ ½–iv
(Mistura Ferri Composita)
(Griffith's mixture)

This preparation contains iron sulphate, potassium carbonate, myrrh, sugar and spirits of lavender.

Elixir of Iron, Quinine and Strychnine Phosphate
(Elixir Ferri, Quiniae, et Strychniae Phosphatum)

This preparation is very frequently used as a tonic. It contains about 2% of iron phosphate.

Each teaspoonful dose contains ½ grain of iron phosphate and quinine and $\frac{1}{64}$ grain of strychnine.

Syrup of Iron, Quinine and Strychnine Phosphate
(Syrupus Ferri Quininae et Strychninae Phosphatum)
4.0–8.0 c.c. ℥i–ii

This preparation contains 9% of iron phosphate. Each teaspoonful dose contains grs. v of iron phosphate, $\frac{1}{80}$ grain strychnine and 1½ grains of quinine.

Antidotes for Arsenic

Iron Hydroxide
(Ferri Hydroxidum)

This preparation is used principally as an antidote for arsenic poisoning. About 8 grains of it will neutralize 1 grain of arsenic. It must always be fresh.

If iron hydroxide is not on hand, it can be made from the tincture of iron chloride, by adding ammonia water or sodium carbonate to it. A precipitate (sediment) will then form. Enough ammonia or sodium carbonate must be added until no more sediment forms. The sediment is then washed and strained, and given in milk; as often as is necessary to neutralize the arsenic.

Iron Hydroxide with Magnesia Oxide 15.0–30.0 gms. ℥ ½–i
(Ferri Hydroxidum cum Magnesii Oxido)

This is made from iron sulphate, to which magnesia is added. It is the best antidote for arsenic poisoning.

Dialyzed Iron (not official) 1.3–2.6 c.c. m. xx–xl
(Ferri Dialysatum)

This is a preparation of iron which is frequently used as an antidote for arsenic poisoning. It is also used in the treatment of anaemia.

ORGANIC IRON PREPARATIONS

The following preparations of iron are made with organic substances such as proteins (albumins, peptones, etc.). They have no advantage over the other preparations of iron, except that they are more readily absorbed, and do not contract mucous membranes as much as the inorganic preparations. Most of them are not official.

Solid Preparations

Iron Tropon (not official) 4.0–8.0 gms. ʒi–ii

This is a preparation of iron with protein, flavored with chocolate.

Haemogallol (not official) 0.25–0.5 gm. grs. iv–viii

This is an organic iron preparation made from blood.

Ferratin (not official) 0.5 gm. grs. vii½

This substance is made from egg albumin and iron.

Ferrous Lactate (not official) 0.06–1.2 gm. grs. i–xx

It is best given in syrup.

Triferrin 0.3 gm. grs. v

This is an organic compound of iron.

Proferrin 0.06–0.3 gm. grs. i–v

This is a compound of iron with nucleoprotein.

Fluid Preparations

Ferro Mangan (not official) 4.0–16.0 c.c. ʒi–ʒ ½

This is a solution of iron, manganese and peptones. There are several other similar preparations under various names, such as peptomanganate of iron, etc.

Ovoferrin (not official) 8.0–16.0 c.c. ʒii–iv

This is a preparation made from serum albumin and iron by an electrical process.

Haemaboloids	15.0 c.c.	℥ss
(Not official)		

This is a compound of iron, proteins and bone marrow.

The following are the most efficient and most frequently used preparations of iron:

Blaud's Pills
Tincture of Iron Chloride
Syrup of Iodide of Iron
Basham's Mixture

and a number of the organic preparations.

Incompatibilities of Iron

The following drugs cannot be given together with iron because they form chemical compounds with it:

Preparations of iron should never be given with tea, or with vegetable drugs containing tannin or tannic acid, as iron combines with these drugs and forms ink.

The alkaline preparations of iron should not be given with acids. For example—do not give Basham's mixture together with dilute acids, as they combine and form a sediment.

The iron salts of the mineral acids should not be given with alkalies. For example—do not give tincture of iron chloride with sodium bicarbonate, as they will combine and form a sediment.

MANGANESE (MANGANUM)

Manganese is a metal. Many of its preparations are occasionally used in medicine. It is found in the body in the red blood corpuscles, the hair and bile, usually together with iron. Some of its preparations, especially potassium permanganate, is used as an antiseptic.

It is said to increase nutrition and is frequently given together with iron. It cannot replace iron, however, as it does not help to form haemoglobin.

Manganese Sulphate (**Mangani Sulphas**)	0.1–0.5 gm.	grs. ii–viii

Manganese Hypophosphate (Mangani Hypophosphis)	0.2 gm.	grs. iii
Potassium Permanganate (Potassii Permanganas)	0.03–0.15 gm.	gr. $\frac{1}{2}$–iii

This preparation gives off oxygen; it is often given in cases of poisoning from various drugs. For example—in morphine poisoning it is given to neutralize the morphine by the oxygen which the potassium permanganate liberates, which then combines with the drug and makes it inactive.

It is also used as an antiseptic, acting in a similar manner, the oxygen destroying the bacteria.

There are a number of unofficial preparations of iron which are combined with manganese.

ARSENIC

Arsenic is a metal which is commonly used in the manufacture of dyes and other commercial products.

It is one of the oldest drugs in medicine, and was very frequently used for criminal poisoning during mediaeval times. There are a number of compounds of arsenic, but only one group of them is used in medicine. These are the compounds of arsenic trioxide, white arsenic or arsenious acid.

Appearance of the Patient

When small doses of arsenic are given for some time, the patient feels better, stronger and is more active. He looks more robust, somewhat stouter and has a ruddier color. The appetite is better and the bowels move more often. The pulse is stronger, somewhat faster and the patient breathes somewhat deeper. In short, the patient feels better and stronger.

ACTION

Local Action: Applied to the skin, arsenic causes inflammation and pain. If it is allowed to remain on the skin for a longer time, the skin is destroyed and an ulcer remains (escharotic or caustic action). Arsenic is slightly antiseptic.

It is easily absorbed from the injured skin. On **mucous membranes,** when applied locally, it also causes redness and pain, with subsequent inflammation and destruction of the tissues.

Internal Action

In the mouth, arsenic has a sweetish taste, causes redness of the lining membrane of the mouth, and increases the flow of saliva.

Arsenic affects principally the stomach and intestines

In the stomach it causes a sense of heat, it increases the appetite and the secretion.

In the intestines, it increases the secretion of the mucous membrane, and the peristalsis, thus causing movements of the bowels.

Action after Absorption

Arsenic is rapidly absorbed from the stomach and intestines, as well as from all the mucous membranes. After absorption, it affects principally the blood and the tissues.

Action on the Blood: Arsenic increases the number of red blood corpuscles by increasing their formation in the bone marrow. Since the red blood corpuscles in the blood are increased, they are able to carry more nourishment and more oxygen to the organs and tissues of the body, and to remove more waste products. Thus they increase the activity of all the organs of the body in the same way as iron does.

The patient is then healthier, more robust, has a better appetite and feels better (tonic action).

Action on the Tissues: Arsenic prevents the tissues from being used up, by lessening their combination with oxygen. It therefore increases the growth and nutrition of the tissues and organs of the body. As a result of this action, if arsenic is taken for some time, the patient usually becomes somewhat stouter.

Action on the Circulation: In the doses that arsenic is usually given, it makes the heart beat somewhat stronger, though the rate of the pulse is not much affected. This is the result of the improvement in the general condition.

Action on the Respiration: By improving the general condition of the patient, the breathing is deeper and faster, the patient takes in more air, and therefore more oxygen for the larger number of corpuscles which the blood contains.

Action on the Brain and Spinal Cord: The brain and spinal cord are somewhat more active, when arsenic is given for some time, because of the improvement of the general health.

Excretion

Arsenic is excreted mainly by the urine, also by the lining membrane of the stomach, intestines and bronchi. It is excreted very slowly and may therefore cause cumulative symptoms.

Tolerance

When arsenic is taken regularly in small quantities, the patients are able to take comparatively large quantities of the drug without getting poisonous effects. A patient is then said to have a **tolerance** for arsenic. This is due to lessened absorption which occurs from continued use.

In some countries, for example in the Tyrol, the peasants eat large quantities of arsenic, because it enables them to do their work better, and to climb the mountains with less effort. It is said to improve their complexion. These peasants often live to a very old age.

Women very often take arsenic for weeks or months at a time to improve their complexion and figure. Poisonous symptoms often occur as a result of such use.

Uses

Arsenic is used principally in **anaemia,** to improve the condition of the blood. It is used especially in those forms of anaemia in which the number of the corpuscles are diminished. It is often given together with iron.

Arsenic is also given for chorea (St. Vitus' dance), and as a tonic, to improve the general condition of the patient. Some of the newer preparations of arsenic are given as a specific for syphilis.

Poisonous Effects

There are two forms of arsenic poisoning:

1. Acute arsenic poisoning.
2. Cumulative arsenic poisoning.

Acute Arsenic Poisoning

This follows a single large dose of arsenic taken with suicidal intent or by mistake. Many rat and insect poisons contain large quantities of arsenic.

Symptoms

The following are the symptoms which occur in about fifteen minutes to an hour:

1. Burning pain in the oesophagus and stomach.
2. Profuse nausea and vomiting of bile stained serum containing small flakes of mucous membrane.
3. Severe abdominal cramps.
4. Profuse diarrhoea, with watery, bloody stools containing small flakes of mucous membrane (rice water stools).
5. Excessive thirst (due to loss of fluid).
6. Scanty, bloody urine.
7. Collapse: cold, moist skin, slow and shallow breathing, rapid, thready pulse, etc.
8. Coma and convulsions may occur before death, which results in from six hours to two days.

In some cases there may not be much nausea, vomiting or diarrhoea. The patient suddenly goes into collapse, has a few convulsions and dies.

If the patient recovers from the acute symptoms, paralysis of the muscles of the extremities may result, causing "drop feet" or "drop hands," from which he usually recovers, however.

Treatment

1. Give iron hydroxide or iron hydroxide with magnesia until recovery.
2. Wash out the stomach, thereby removing the compound of iron and arsenic. Induce vomiting if no stomach tube is at hand.

3. Protect the mucous membrane of the stomach and the intestines by giving mucilaginous drinks such as milk, olive oil, etc.

4. Give plenty of water.

5. Later, bismuth, chalk or opium may be given for the diarrhoea.

6. Abdominal cramps are usually relieved by a hot water bag and by atropine.

7. The collapse is usually treated with caffeine, atropine, strychnine, warm applications, etc.

Cumulative Arsenic Poisoning

Since arsenic is excreted much slower than it is absorbed, cumulative symptoms, or chronic arsenic poisoning is very common. It usually occurs from the continued medicinal use of arsenic preparations. It may also result from inhaling fumes of arsenic, in rooms papered with wall paper containing arsenic dyes, from wearing clothing dyed with arsenic, or by eating food colored with arsenic dyes. The following symptoms, in the order of their onset, are noticed after prolonged administration. Often the later symptoms appear before the earlier ones.

Symptoms

1. Itching of the eyelids.
2. Redness of the conjunctiva of the eye.
3. Puffiness about the eyes, especially in the morning.
4. Sneezing, "running nose" (coryza).
5. Tightness in the throat.
6. Hoarseness.
7. Loss of appetite, heaviness in the stomach, nausea and vomiting.
8. Skin eruptions; red spots, areas of brownish discoloration (very often they look like freckles) on the face or the abdomen. Dark discolorations on the skin of the abdomen, which look like pencil marks.

In severe cases, the hair and nails may fall off.

9. Cramp-like abdominal pains.

10. Diarrhoea, with "rice water" stools; the rice water appearance of the stools is due to small flakes of the lining membrane of the intestine which they contain.

The following symptoms appear later and only in severe cases:

11. Persistent headache.

12. Pains around the knee, ankle, foot and hands.

13. Redness and swelling of the hands and feet.

14. Areas of skin, especially on the extremities, which are very sensitive to touch, to pain, to heat and cold.

15. In severe cases there are paralyses of the extensor muscles of the hands and feet, resulting in "drop feet" and "drop hands."

Treatment of Chronic Arsenic Poisoning

If the arsenic is stopped and cathartics given, the symptoms usually gradually disappear. The paralyses must be treated by massage and electricity, until the muscles recover; which they usually do.

Preparations

Fluid Preparations:

Solution of Potassium Arsenite 0.06–0.5 c.c. m. i–viii
(Liquor Potassii Arsenitis)
(Fowler's solution)

This contains 1% of arsenic trioxide, potassium bicarbonate and tincture of lavender.

Five minims of Fowler's solution contain $\frac{1}{20}$ gr. of arsenic trioxide.

Solution of Sodium Arsenite 0.06–0.5 c.c. m. i–viii
(Liquor Sodii Arsenitis)
(Pearson's solution)

Solution of Arsenious Acid 0.06–0.5 c.c. m. i–viii
(Liquor Acidi Arsenosi)

This contains 1% of arsenic trioxide and dilute hydrochloric acid.

Solution of Arsenious and Mercuric Iodides 0.1–0.3 c.c. m. $1\frac{1}{2}$–v
(Liquor Arseni et Hydrargyri Iodidi)
(Donovan's solution)

This is the strongest arsenic preparation. It contains 1% each of arsenic iodide, and of red mercuric iodide. It may cause symptoms of mercury poisoning.

Solid Preparations:

Arsenic Trioxide (Arsenii Trioxidum)	0.001–0.005 gm.	gr. $\frac{1}{60}$–$\frac{1}{12}$
Sodium Arsenate (Sodii Arsenas)	0.001–0.005 gm.	gr. $\frac{1}{60}$–$\frac{1}{12}$
Arsenic Iodide (Arsenii Iodidum)	0.003–0.01 gm.	gr. $\frac{1}{20}$–$\frac{1}{6}$
Sodium Cacodylate (Sodii Cacodylas)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i

This is a compound of cacodylic acid, which is a compound of arsenic. It is given hypodermically and is said to cause no unpleasant symptoms.

Arsen Triferrin (unofficial) 0.3 gm. grs. v

This a compound of iron, arsenic, phosphorus and albumin.

Soamin (not official)

This is sodium arsanilate, and contains 22% of arsenic. It usually comes in tablets each containing 0.06–0.3 gm. (grs. i–v) of soamin.

Salvarsan "606"	0.3–0.6 gm.	grs. v–x
Neosalvarsan	0.3–0.6 gm.	grs. v–x

These are organic compounds of arsenic which are used as specifics for syphilis. They are given intravenously, as an intravenous infusion, or by deep injection into the muscles. Salvarsan has to be very carefully neutralized with an alkali. Both preparations come in closed glass tubes containing nitrogen gas and the powder.

Atoxyl

This is Sodium Arsanilate, and comes in tablets of 0.02 gm. (gr. $\frac{1}{3}$) for hypodermic use.

Administration

Arsenic preparations should be given well diluted in a large glass of milk after meals.

BENZOL

Benzol is an oily colorless inflammable liquid made from coal tar. It is used in metal manufacturing as a solvent. The fact that very severe anæmias occur among such metal workers is responsible for its use in medicine for conditions where there is an increase in the number of blood cells.

It is therefore used in the treatment of Leukæmia, a progressive and fatal disease characterized by a marked increase in the number of leucocytes in the blood and a change in their character. Benzol causes destructive changes in the bone marrow where the blood cells are formed as a result of which the number of leucocytes diminish and the patients improve, but the improvement is not permanent however. It is given in doses of 0.5 to 1.0 c.c. in milk or olive oil.

Benzol must not be confounded with benzine, an entirely different substance made from petroleum.

CHAPTER XII

CIRCULATORY STIMULANTS

Physiology of the Circulation of the Blood

The blood supplies all the organs and tissues of the body with nourishment and takes away their waste products. It reaches these organs and tissues, through numerous small elastic tubes, the arteries. These gradually divide into smaller branches so that the narrowest are called capillaries. The blood is kept constantly flowing through these vessels by the rhythmic action of a complicated pump, the heart.

The impure blood resulting from the action of the tissues and organs is being constantly brought back to the heart by means of a system of tubing called the veins.

Physiology of the Heart

The heart is a pear-shaped organ, about the size of one's fist, situated in the left side of the chest. It consists of four chambers. Two of these chambers receive blood into the heart from the veins, and are called **auricles,** while two of them send blood out to the organs and tissues of the body and are called **ventricles.**

The **right auricle receives** impure blood (blood containing waste products) from the various organs and tissues of the body through the veins, which enter the heart by two main vessels: the Superior and Inferior Vena Cava. The impure blood is then pumped into the next chamber, which is the **right ventricle.** From the **right ventricle** it is pumped into a large artery, the **pulmonary artery,** through which it reaches the lungs. Here some of the waste products of the blood are excreted by the corpuscles. In return, the red corpuscles **take up oxygen** from the air in the lungs.

This **purified blood** is now carried back along the **pulmo-**

nary veins, to the **left auricle**, and from there it is pumped into the **left ventricle**. The **left ventricle** then pumps the blood into the large arteries: the **aorta and its branches**. The blood then passes through these arteries and their branches, to the various organs and tissues of the body, supplying them with oxygen and nourishment. In return it takes away the waste products from these tissues and organs. It then brings these waste products back to the heart, and thence to the lungs, where they are excreted, and new oxygen obtained instead.

The passage of the blood, to the various parts of the body from the heart along the arteries, and then back again to the heart along the veins, is called the circulation of the blood.

The blood is kept circulating by the regular rhythmic contractions of the heart, which in normal healthy individuals, occur about 72 times a minute.

Each contraction consists of two parts or phases:

1. The period of contraction, which is the time when the heart becomes smaller and expels its contents, the blood. This is called the **systole of the heart.**

2. The period of relaxation, or period of rest, which is the time when the heart becomes larger, and contains a greater amount of blood. This is called the **diastole of the heart.**

Physiology of the Heart Muscle

It is now generally believed that the heart contracts because of characteristic intrinsic properties of heart muscle. These properties are independent of the impulses which reach the heart through its nerves. This may be proved by the fact (among others) that the hearts of some animals will contract for a short time when the nerves are severed from the heart; in fact even when the heart is removed from the body. Physiologists have therefore studied the nature of the contractions of the heart and have brought to light the following facts:

(1) Heart muscle, like other muscles has the following properties: **irritability, tone** and **contractility.**

Irritability is the property whereby muscles are constantly ready to respond to a stimulus.

Tone is the property whereby muscles maintain a state of constant mild contraction.

Contractility is the property whereby muscles are able to contract, that is, to become shorter and thicker. The heart muscle differs from other muscles, however, in its contractility. Whenever it contracts at all, it always contracts to the greatest degree.

(2) Living normal heart muscle always contracts rhythmically.

(3) The auricles and ventricles of the heart are both capable of contracting independently of one another. When they do so, the auricles and ventricles beat at different rates. The auricles then beat about three times as fast as the ventricles, whose intrinsic rate is about forty to the minute.

(4) Contractions of the auricles are transmitted to the ventricles along a bundle of muscle fibers, which runs in the septum of the heart, from the auricles to the ventricles and is called the **auriculo-ventricular bundle,** or bundle of His.

(5) The wave of contraction of the heart begins at a point in the right auricle where it is joined by the great veins (Superior and Inferior Vena Cava). This spot is called the **sinus node.** It is the most irritable part of the heart and is frequently called the **pace maker** of the heart because it starts the contraction.

Method of Contraction

(1) The stimulus at the sinus node starts the contraction of the auricles. This contraction wave is then transmitted to the ventricles by the auriculo-ventricular bundle. Ventricular contractions then follow about a fifth of a second later. These ventricular contractions pump blood into the arteries and give the pulse its rate.

These rhythmic contractions occur about 72 times to the minute in the following order:

Contraction of Sinus Node
Contraction of Auricle
Contraction of Ventricle

Each contraction is followed immediately by its period of relaxation or **diastole.**

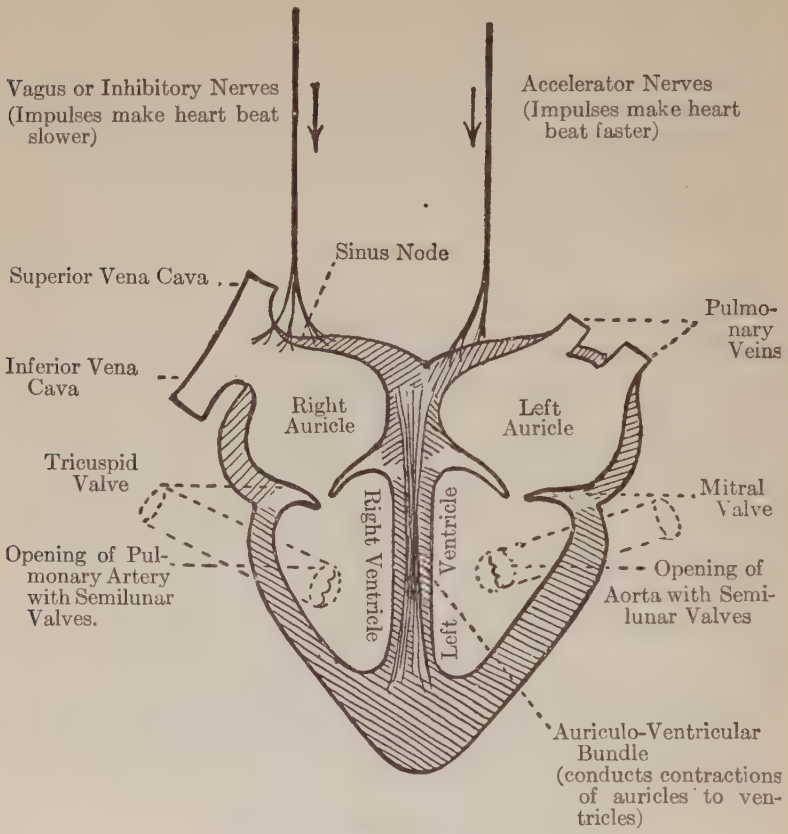


Diagram of the heart showing the position of the auriculo-ventricular bundle, and the nerves.

Heart Block

When the auricular contractions fail to reach the ventricles, because the passage of contraction waves along the auriculo-ventricular bundle is interfered with, the condition is called **heart block.** The auricles and ventricles then beat independently of one another but each at its own intrinsic rate; the ventricles beating much slower than the auricles, usually about 30 or 40 times a minute. Since the ventricular

beats cause the pulse, the patient will have a pulse of 30 or 40.

Heart block frequently results in various diseased conditions of the heart. It can also be produced by digitalis and by mechanical measures in laboratory experiments.

Partial Heart Block

When some of the auricular contractions do reach the ventricles, the condition is known as partial heart block.

Fibrillation

When the heart muscle becomes excessively irritable, all its bundles of fibers do not beat in harmony and its rhythm is therefore disturbed. This condition is known as **fibrillation.** It is usually due to increased irritability of the heart as a result of disease or other conditions. **Auricular fibrillation** is a condition in which groups of muscle fibers in the auricles beat by themselves and thus disturb the rhythm of the heart. **Ventricular fibrillation** is a condition in which bundles of muscle fibers of the ventricles beat independently, thus disturbing the rhythm of the ventricles. This condition is usually fatal.

Factors which Modify the Contractions of the Heart

The contractions of the heart can be affected by the following influences:

1. By **impulses** coming from the medulla of the brain through the sympathetic system, along special nerves going to the heart called the **accelerator nerves.** The impulses transmitted by these nerves, cause the heart to beat **stronger and faster.** As a result, the contractions or **systoles are stronger,** and **more frequent;** while the relaxation or diastoles of the heart are diminished.

2. By **impulses** coming from the medulla of the brain along special nerves going to the heart called the **Vagus, Pneumogastric or inhibitory nerves.** These impulses make the heart beat **slower and weaker.** As a result, the relaxation

periods or **diastoles, are greater** and more prolonged. The contractions or systoles, therefore, occur less frequently because the periods of relaxation of the heart, or diastoles, take up so much time.

3. **The width of the blood vessels,** especially of the very small arteries, also influences the contractions of the heart.

When the **blood vessels are contracted, the heart must beat stronger;** because the narrow blood vessels offer a greater resistance to the contractions of the heart.

When the **blood vessels are dilated,** the heart does not have to contract so forcibly to propel the blood through the widened blood vessels, because they offer little resistance to the flow of blood.

The width of the blood vessels is regulated by small muscle fibers in their walls. The contractions of these muscle fibers make the blood vessels narrower. By the relaxation of these muscles, the blood vessels become wider.

Impulses are constantly being sent from a spot of gray matter in the medulla of the brain (the vaso motor center), which cause these muscle fibers to either contract or relax, and thereby regulate the size of the blood vessels.

Effects of Drugs on the Heart

Drugs affect the heart in two ways:

1. They **increase** its activity (stimulation).
2. They **diminish** its activity (depression).

Stimulation of the Heart

When drugs increase the activity, or stimulate the heart, they make it beat stronger and faster. The contractions or systoles of the heart are stronger, while the period of relaxation or diastoles are lessened. The pulse is therefore usually stronger and more rapid, because the character of the pulse depends largely on the contractions of the heart. Practically, however, most heart stimulants also act upon the heart to make it beat slower. This is a beneficial effect; as it prevents the heart from becoming exhausted.

Methods of Heart Stimulation

The **increased activity** of the heart is produced in several ways:

a. By acting directly on the **heart muscle** to make it contract more forcibly, more frequently and more rhythmically. This may be due to increasing the tone, the irritability and the contractility of the heart muscle or all three.

b. By causing **more impulses** to be sent along the **accelerator nerves,** thus making the heart beat stronger and faster.

c. By **paralyzing the nerve endings** in the heart of the **Vagus or inhibitory nerves,** so that all impulses for slowing the heart do not reach the heart muscle. The **heart then beats stronger and faster;** the systoles or contractions are increased, while the diastoles or periods of relaxation are diminished.

d. **By improving the circulation within the heart muscle** itself, thus improving its nourishment so that it is enabled to contract better.

e. **By contracting the small muscle fibers in the walls of the small blood vessels.** The contractions of the heart are thus increased so as to overcome the greater resistance offered by the narrower blood vessels. The contraction of the small blood vessels always increases the blood pressure, and a rise in blood pressure always causes a reflex slowing of the heart.

Many drugs increase the heart action in one or a number of these ways.

Depression of the Heart

When drugs lessen the activity of the heart (depression), the heart beats slower and weaker. The contractions or systoles are lessened, while the periods of relaxation or diastoles, are increased. The heart therefore beats slower and weaker causing a slow and weak pulse.

Methods of Heart Depression

Depression of the heart is produced in several ways:

a. **By directly affecting the heart muscle** so that the heart beats slower and the contractions are weaker. This may be due to lessening the irritability, the tone or contractility of the heart muscle or all three.

b. **By sending impulses from the medulla** of the brain along the **Vagus or inhibitory nerves** to cause the heart to beat slower and weaker. This effect can also be produced by **increasing the action of the nerve endings** of the Vagus nerve in the heart; which then become more susceptible to receive such impulses.

c. **By paralyzing the nerve endings** in the heart of the accelerator nerves. The impulses for increasing the heart action are thus eliminated; and the heart beats slower and weaker.

d. **By causing the small muscle fibers in the walls of the blood vessels to relax,** thereby widening these vessels. The heart then contracts less vigorously but more rapidly because of a lessened resistance.

Practically, however, a drug usually affects the heart in several ways. It may frequently stimulate certain parts of the mechanism of the heart while depressing others.

Effects of Overdoses

In overdoses, the effects of a heart stimulant or of a depressant may be the same. For example, when the heart action is increased, the heart beats strong and fast, but when it is overacting and is exhausted, the beats become slow and weak. In poisonous doses then, a heart stimulant may cause symptoms of depression.

A drug which **lessens** heart action, however, or a heart depressant, always makes the heart beat slow and weak. In overdoses, such a substance makes the heart beat even slower and still weaker.

HEART STIMULANTS

DIGITALIS GROUP

The drugs in the following group, have practically the same action with slight variations:

Digitalis Purpurea, Purple Foxglove
Strophantus Hispidus or Kombe, Strophantus
Scilla Maritima, Squills

The most efficient member of the group is digitalis.

The following drugs are less frequently used:

Convallaria Majalis, Lily of the valley
Helleborus Niger, Christmas rose
Apocynum Canabinum, Canadian hemp
Adonis Vernalis, Pheasant's eye
Antiaris, Upas tree
Nerium, Oleander

and a number of others.

Some of these drugs, for example strophantus, were used by the natives of Africa and in other Eastern countries as arrow poisons. Others were known for a long time before they were ever used in medicine.

DIGITALIS

Digitalis is a drug obtained from the leaves of the **Digitalis purpurea,** or **Purple foxglove,** which grows in most temperate climates. The English leaves are the best.

The leaves of the second year's growth are mostly used in making digitalis preparations, because they contain the largest amount of the active principles.

The active principles of Digitalis are the following three glucosides:

Digitoxin
Digitalin
Digitalein

Digitoxin is the most potent of all, and is largely responsible for the digitalis effects.

Digitalis also contains a saponin, **digitonin,** which is inactive, however, except that it may occasionally be responsible for the nausea and vomiting.

The presence of digitonin in the leaves enables the active principles to be dissolved in water and to prepare therefore such a preparation as the infusion. In alcohol, however, all the glucosides except the digitalein and the digitonin dissolve very readily. The Tincture of Digitalis therefore represents the activity of the drug devoid of the undesirable digitonin; besides, it keeps for a long time.

ACTION

Local Action: When injected hypodermically, digitalis is injurious to the tissues. It often causes inflammation and occasionally an abscess.

On mucous membranes: It causes pain, redness, profuse secretion of mucus, and often inflammation.

Internal Action

In the mouth: Digitalis has a bitter and unpleasant taste.

In the stomach: Many of the preparations of digitalis cause nausea and vomiting. This is due to action on the vomiting center, since it usually occurs after the drug is absorbed.

In the intestines: Digitalis occasionally causes diarrhoea, because of the irritation of the lining membrane of the intestines.

Action after Absorption

Digitalis preparations are very slowly absorbed into the blood from the intestines. It usually takes about 12 to 36 hours for the effects of the drug to develop. If given hypodermically, it enters the blood sooner, and the effects appear more rapidly.

Since digitalis is so slowly absorbed, it produces prolonged effects. It is therefore the best drug to give to a patient suffering from chronic weakened heart action (myocardial insufficiency).

After absorption, digitalis affects principally the heart, the medulla of the brain and the kidneys.

Action on the Heart: Digitalis makes the heart beat slower and stronger, consequently the pulse becomes slower and stronger.

This is the result of the following four effects on the heart:

(i) It makes the heart muscle contract more forcibly and more rhythmically, by increasing its contractile power and tone (see page 207). As a result the heart contracts more

forcibly and expels its contents completely. With each contraction or systole a greater quantity of blood is pumped from the auricles into the ventricles and thence into the arteries.

(2) It sends more impulses from the medulla of the brain along the Vagus or inhibitory nerves to make the heart beat slower, thereby prolonging the periods of relaxation or diastoles of the auricles and ventricles.

(3) It causes the auriculo-ventricular bundle to conduct fewer contraction waves from the auricles to the ventricles, thus producing a partial heart block (see page 214). In addition to the action on the Vagus nerve this also tends to slow the rate of the ventricles and to prolong their diastoles.

(4) It improves the circulation of blood within the heart muscle itself, supplying it with more and better nourishment and thus strengthening its contractions.

This improved circulation is brought about by the more forcible contractions, and by the prolonged periods of rest which follow. The more forcible contractions squeeze all the blood out of the heart muscle itself, and the subsequent prolonged rest permits a thorough circulation of the blood through the heart muscle. With each diastole (during which the blood circulates within the heart muscle), the heart is therefore refreshed with pure oxygenated, more freely circulating blood.

The total result of these influences is to induce slow regular rhythmic contractions of the heart which cause a regular slow strong pulse.

Effect on the Circulation

With each prolonged period of rest or diastole the heart fills up with larger quantity of blood. With each succeeding contraction or systole a large quantity of blood is pumped into the arteries and is kept circulating more freely. The blood itself is of better quality because the improved circulation in the lungs enables the red blood cells to take up more oxygen.

Secondary Effects

As a result of the improved circulation, the various organs and tissues of the body are constantly receiving more and

better blood which improves their nourishment and enables them to perform their work better. Stagnation of blood in these organs is relieved. Accumulated fluid in the tissues (oedema) is gradually removed.

The slow rate at which the improved action of the heart and circulation (including the circulation within the heart itself) occurs, prevents exhaustion of the heart muscle from overactivity. It also allows the heart to recuperate from the effects of deleterious influences, be they the poisons of disease or unfavorable social conditions that were responsible for the disturbance of an already diseased heart and poor circulation.

The effect of digitalis on the heart may be compared to a driver driving a lagging horse. The lagging horse is the weakened heart, which is not doing enough work. The driver is the digitalis.

The driver whips the horse to make him go faster and more energetically; but lest the horse overwork himself by going too fast, the driver keeps him in check by pulling in the reins. The horse then works energetically, though not fast enough to exert himself.

After digitalis, the heart works energetically; but lest it be overworked, it is checked by the slowing impulses of the Vagus or inhibitory nerves and by the lessened conductivity of the auriculo ventricular bundle, which prevent it from becoming exhausted.

Action on the blood vessels: The doses of digitalis usually given to patients have no appreciable effect on the blood vessels. In laboratory experiments, however, the blood vessels are made narrower by the contraction of their muscle fibres.

Effect on blood pressure: The blood pressure (the pressure under which blood flows in the vessels) may not be affected at all by digitalis. Frequently, however, the blood pressure may be either raised or lowered, according to whether it was low or high as a result of the circulatory disturbance of the patient.

Action on the brain: Digitalis affects only the medulla of the brain, especially that part of its gray matter which

sends out impulses to slow the heart (vagus center). In overdoses, it also sends out impulses for vomiting; and in such doses the impulses for motion may be increased so much that convulsions may result.

Action on the kidney: Digitalis increases the flow of urine very markedly; especially in cases where the tissues contain a great deal of fluid (oedema).

The increased secretion of urine is caused in two ways:

a. **By removing fluid from the tissues:** The freely moving current of blood prevents its stagnation in the veins and capillaries. The excessive fluid in the tissues then passes into these vessels (is absorbed). The quantity of fluid in the blood is thus increased and the excess is eliminated by the kidney, increasing the quantity of urine.

b. **By improving the circulation in the kidney:** Since the current of blood in the kidneys flows more vigorously, more fluid is brought, and oftener, for the kidney to excrete.

Poisonous Effects

Since digitalis is slowly absorbed, and excreted still more slowly, it does not cause acute poisonous symptoms.

Cumulative Digitalis Poisoning

Cumulative digitalis poisoning frequently results from its continued administration. Whenever it is necessary to administer digitalis for a long time cumulative symptoms may be avoided by gradually reducing the frequency of the administration or by discontinuing the drug entirely, at intervals.

Symptoms

1. Persistent nausea and vomiting
2. Diarrhoea
3. **Slow pulse; below 60, which may be irregular**

This is the most important symptom of digitalis poisoning and should always be reported to the physician. It means that a condition of heart block has been produced.

In severe cases, or from an overdose given intravenously, in addition to the sudden onset of the foregoing symptoms

there may be **weakness, headache, disturbance of vision and dizziness.** On the slightest exertion the pulse may become very rapid (130–150), weak and irregular, the breathing becomes slow and deep and the urine may be scanty.

Treatment

1. Stop the digitalis as soon as the pulse gets below 60 and is irregular. This is usually sufficient in most cases.
2. Keep the patient absolutely quiet.
3. Apply an ice bag or a hot water bag to the region of the heart.
4. Atropine and morphine are the drugs usually given to relieve the condition.

Administration

For rapid effect, as in collapse, only some of the newer unofficial preparations are given. They act more quickly than other preparations and can be given hypodermically.

All preparations of digitalis should be given in a wineglassful of water slightly flavored. They should always be given between meals when the stomach contains little acid. The presence of large quantities of acid in the stomach lessens the absorption of digitalis preparations.

Digitalis preparations should be fresh and made from reliable English leaves. The failure to obtain results from digitalis is often due to unreliable preparations.

COMMON DISEASES OF THE HEART

The following are the more common conditions in which digitalis is generally used:

Myocardial Insufficiency is the only condition in which the nurse may observe striking effects from the use of digitalis. In the other conditions only its characteristic effect on the pulse may be observed.

Myocardial Insufficiency

(Failing Compensation or Weakened Heart Action)

The contractions of the heart keep the blood circulating through the blood vessels, so that the tissues and organs of

the body may be supplied with nourishment and oxygen, and their waste products removed.

When disease affects the valves of the heart, the valve openings become narrower (stenosis), or the valves do not close completely and leak (regurgitation). The heart overcomes the resulting disturbed flow of blood in its cavities, by thickening its wall. The heart is then able to contract with greater force which overcomes the leaking or narrow valves, and it is then said to be compensated.

When, however, the heart muscle is weak, or when there is auricular fibrillation so that the rhythm is disturbed, the blood cannot be moved along the blood vessels fast enough. Some of the blood then accumulates in the veins of the lungs, of the extremities, and of the abdomen.

When the blood accumulates in the blood vessels of the lungs, the air sacs become narrower. To obtain the necessary amount of air in his lungs, the patient therefore has to breathe faster and deeper. The blood corpuscles cannot take up enough oxygen, and the blood becomes darker in color which causes the skin of the face and hands to become blue.

Some of the blood also accumulates in the veins and capillaries of the extremities. Part of the serum of this accumulated blood, oozes through the walls of the vessels into the surrounding tissues. The tissues, particularly of the lower extremities, then become full of fluid (oedema).

In the abdomen too, the accumulation of the blood, in the blood vessels of the stomach and intestines, results in congestion and oedema of the stomach and intestines. This causes nausea, vomiting and diarrhoea.

The accumulation of the blood in the kidneys, results in lessened secretion of urine, because the kidneys are not supplied with sufficient fresh blood from which to excrete urine.

Often the serum oozes through the walls of the blood vessels into the abdomen, filling it up with fluid (ascites).

As a result of this weakened heart action or fibrillation of the auricles, patients present the following picture:

At first they are very short of breath and the face is blue (cyanosed). Later the extremities are swollen (oedema), and

in some cases, the patients have nausea, vomiting and even diarrhoea. **The pulse is rapid, often irregular and weak.**

Appearance of the Patient after Digitalis

When digitalis is given to patients suffering from failing compensation or myocardial insufficiency, all the symptoms disappear. Within a few days after its administration is begun, the patient breathes easier and the blue color of the skin disappears. The swelling of the extremities (oedema) gradually becomes lessened until it completely disappears. The pulse is stronger and slower. More urine is passed and the nausea and vomiting disappear.

Acute Myocardial Insufficiency

(Sudden Weakened Heart Action)

This condition frequently results from shock, following operations or from collapse from any cause. As a result the tone and contractile power of the heart muscle is lessened. The condition is characterized by a weak, regular, either rapid or slow pulse. The administration of **hypodermic preparations** of digitalis usually produces the characteristic slow and strong pulse.

Auricular Fibrillation

(See page 215.) This condition is of common occurrence but can be recognized only by elaborate apparatus. Without such apparatus its presence may only be suspected by the rapid and irregular pulse. It is frequently the cause of the weakened heart action which produces the symptoms of "failing compensation" in conditions of diseased valves of the heart. Digitalis usually relieves the condition by regulating the rhythm of the heart and producing a beneficial "heart block" with its characteristic slow strong pulse.

Heart Block

(See page 214.) This condition is the result of disease of the heart in which the auriculo-ventricular bundle is affected. It is characterized by a very slow pulse with periodic fainting spells. It is only recognized with certainty by the use of very elaborate apparatus. Digitalis should never be given

to such patients as it only tends to aggravate the condition.

Preparations

Solid Preparations

Digitalis (Powdered leaves) (Digitalis)	0.03–0.1 gm.	grs. ½–ii
Extract of Digitalis (Extractum Digitalis)	0.0075–0.03 gm.	grs. ⅛–½

Fluid Preparations

Infusion of Digitalis (Infusum Digitalis)	4.0–16.0 c.c.	ʒi–ʒss

The usual official infusion is a 1.5% solution, or one part of digitalis to 66⅔ parts of water.

Many physicians order weaker infusions; such as 1–150 etc. The dose for such infusions is correspondingly greater.

Fluidextract of Digitalis (Fluidextractum Digitalis)	0.06–0.12 c.c.	m. i–ii
Tincture of Digitalis (Tinctura Digitalis)	0.3 –1.0 c.c.	m. v–xv

This preparation keeps well and is perhaps the most reliable one.

New and Non-official Preparations

Many of the following preparations are used extensively and are very reliable. Some of them can be given hypodermically, because they produce effects rapidly.

Digalen (Liquor Digitoxin Solubilis)	0.6–2.0 c.c.	m. x–xxx

Digalen is a solution containing digitoxin, the most active glucoside of digitalis, dissolved in a mixture of distilled water, glycerin and a very small amount of alcohol. It is given hypodermically, and produces its effects in from one to two hours.

It is also given intravenously in doses of 0.3–1.0 c.c. (m. v–xv) producing effects in from 15 minutes to a half hour.

Digalen Tablets: Each tablet contains the same amount of digitoxin that is contained in 0.5 c.c. (m. viii) of digalen.

Digipuratum or Digitan 0.1 gm. gr. i$\frac{1}{2}$

These are tablets made from specially grown digitalis leaves from which many of the inactive substances have been removed. It is not so apt to cause nausea and vomiting. Each dose contains enough digitoxin to kill a frog weighing 30.0 gms. by stopping its heart beat. The tablets are given four times a day, and reducing one tablet a day until ten are taken, then they are stopped. This allows the patient to eliminate the accumulated drug, thus avoiding cumulative effects.

Digipuratum also comes in ampoules for hypodermic use, each containing 1.0 c.c., equivalent to 0.1 gm. (gr. 1$\frac{1}{2}$) of digipuratum.

Digitoxin 0.00025 gm. gr. $\frac{1}{250}$

This is not often used, as it cannot be dissolved easily.

Digifolin 0.3–1.0 c.c. mv–xv

This is a soluble preparation of digitoxin. It comes in glass ampoules each containing 1.0 c.c. and is used hypodermically or intravenously.

Digipoten (tablets) 0.3–1.0 c.c. m. v–xv

This is a mixture of the digitalis glucosides in soluble form.

Digitol 0.3–1.0 c.c. m.v–xv

This is a fat free tincture of digitalis of the same strength as the ordinary tincture. It also comes in air tight ampoules each containing 30.0 c.c.

There are several preparations of digitalins. They are not used very much because their action is unreliable. Many of them are made from the digitalis seeds, and contain very few active principles.

STROPHANTUS (STROPHANTUS)

Strophantus is a drug obtained from the ripe seeds of the Strophantus hispidus, a climbing shrub of Africa. It has been used for a long time by the natives of that country, as

an arrow poison under various names; such as kombé, ineé, ouaye, or pahouius poison. Its active principle is a glucoside, **strophantin.**

ACTION

Strophantus acts like digitalis but its effects vary in the following instances:

1. When given by mouth it may not be absorbed; therefore its effects are unreliable.
2. It increases the contraction of heart muscle more than digitalis does.
3. It is much more poisonous than digitalis; the poisonous effects appear more suddenly and are more severe.
4. It frequently causes profuse diarrhoea.
5. It is more rapidly eliminated than digitalis.

Its active principles, however, are very useful for intravenous use.

Preparations

Tincture of Strophantus (Tinctura Strophanti)	0.3–1.0 c.c.	m. v–xv
Strophantin (K) (The active glucoside)	0.0003–0.001 gm.	gr. $\frac{1}{200}$–$\frac{1}{60}$

This is not very reliable, since its composition varies. It must be freshly prepared.

Ouabain (Crystallized Strophantin) (Unofficial)	0.003–0.025 gm.	gr. $\frac{1}{20}$–$\frac{2}{5}$

This is given intravenously and intramuscularly, well diluted in doses of gr. $\frac{1}{130}$. It is obtained from a species of Strophantus and is more active than the ordinary strophantin.

SQUILLS (SCILLA)

Squills is obtained from the bulb of the **Unginea maritima** or **Squills maritima,** the sea onion, a plant growing in the southern part of Europe. The outer coat of the bulb is

removed, and the bulb is then cut into slices. From these slices the preparations are made. The active principle is a glucoside, **scillain.**

ACTION

Squills acts like digitalis but it is not as reliable. It is more rapidly absorbed, however, and after absorption it especially increases the secretions of all mucous membranes. It is therefore frequently used to loosen and increase the cough, especially in old people. In such patients the mild improvement of the heart action and the increased secretion of the kidneys benefit the general health as well.

Preparations

Syrup of Squills (Syrupus Scillae)	2.0–4.0 c.c.	$3\frac{1}{2}$–i
Compound Syrup of Squills (Syrupus Scillae Compositus)	0.6–2.0 c.c.	m. x–xxx

This contains squills, senega and tartar emetic.

Guy's or Fothergill's Pill

This contains calomel, squills, digitalis (powdered leaves); of each 0.06 gm. (gr. i). It is an excellent diuretic. Squills is usually given in pill form for diuretic action. As an expectorant the syrup is usually given. It is also contained in Stokes' expectorant.

CONVALLARIA (LILY OF THE VALLEY)

Convallaria is obtained from the roots and underground stems of **convallaria majalis** or lily of the valley. Its active principle is a glucoside, convallamarin. It also contains a saponin, **convallarin.**

Convallaria acts like digitalis, but is not as reliable. It is more poisonous than digitalis, however.

Preparations

Fluidextract of Convallaria (Fluidextractum Convallariae)	0.3–1.0 c.c.	m. v–xv

APOCYNUM (CANADIAN HEMP)

Apocynum is obtained from the root of the **Apocynum**

cannabinum, Canadian hemp or milkweed. Its active principle is **apocynein,** a glucoside. It acts like digitalis but is unreliable and very expensive. It makes the heart beat slower and stronger and increases the secretion of the urine. It is not so apt to cause cumulative symptoms.

Preparations

Fluidextract of Apocynum (Fluidextractum Apocyni)	0.3–2.0 c.c.	m. v–xxx

ADONIS VERNALIS (not official)

Adonis vernalis is the root of the **Adonis vernalis,** a plant of northern Europe and Asia. Its active principle is a glucoside, **adonidin.**

It acts like digitalis but is unreliable.

CAMPHOR (CAMPHORA)

Camphor is obtained from the **Laurus camphora** or **Cinnamomum camphora,** an evergreen tree growing in China and Japan It has been used by the Chinese for many centuries.

It is made by chopping up the root, stems and branches of the tree into fine pieces and boiling them in water. The volatile oil which the plant contains then rises to the top. When the fluid is allowed to cool, part of the oil evaporates and leaves a thick film, which is the camphor. This is then skimmed off, purified and used as a drug. The sediment which remains when a volatile oil evaporates is called a **stearoptene.**

Menthol is a similar stearoptene used in medicine. It is obtained from the oil of peppermint.

Thujon is another similar substance obtained from the oil of wormwood. It therefore occurs in absinthe, and causes the convulsions of chronic absinthe drinkers.

Appearance of the Patient

About a half to one hour after an ordinary dose of camphor is given, the patient becomes calm and quiet, though somewhat exhilarated. He has a feeling of warmth in the stomach. The pulse may be stronger, but the rate may

be slow or fast and the patient breathes faster and easier. When it is given hypodermically, these effects appear sooner.

ACTION

Local action: Applied to the skin, camphor causes redness and a feeling of warmth. It relieves pain at the spot where it is applied, and is slightly antiseptic.

On mucous membranes: It causes slight contraction and is antiseptic.

Internal Action

In the mouth: Camphor has a hot, bitter taste.

In the stomach: It causes a feeling of warmth, checks the formation, and hastens the expulsion of gas (carminative action).

In the intestines: It often checks diarrhoea and aids in the expulsion of gas.

Action after Absorption

Camphor is absorbed from the stomach in a few hours. After absorption it affects principally the heart, the respiration, the brain and the secretions.

Action on the heart: Camphor may make the heart beat stronger. The rate may be faster or slower. Frequently camphor has no effect on the heart at all.

The blood vessels are widened, however, and the pulse may have a bounding quality and be either slow or fast.

Action on the respiration: Camphor makes the patient breathe faster and deeper. This action is not always marked.

Action on the brain: In the doses that camphor is usually given, it makes the patient feel calm and quiet, though somewhat exhilarated. This is due to increasing the controlling or inhibitory influences over the impulses usually sent out from the brain. In larger doses the action of the brain is increased. The patient then becomes more active and more talkative.

In poisonous doses, the action of the entire brain is increased, the brain sending out so many impulses, for motion, speech, etc., that convulsions and delirium may occur.

Action on secretions: Camphor slightly increases the secretions, especially the sweat and mucus.

Excretion

Part of the camphor is used up by the tissues of the body. The rest is eliminated in a few hours by the kidneys, sweat and foeces.

Poisonous Effects

Overdoses of camphor produce the following symptoms, though they are rarely fatal:

1. Burning pain in the stomach.
2. Headache.
3. Dizziness.
4. Delirium.
5. Convulsions.
6. Weakness in the extremities.
7. Weak, small pulse, rapid or slow.
8. Pale, cold, moist skin.

These symptoms disappear when the drug is stopped.

Uses

Preparations of camphor such as the liniment, are used to relieve pain, in sprains or muscular rheumatism.

It is used as a heart stimulant, and often to lessen nervousness.

Recently, pneumonia has been treated by repeated intramuscular injections of 10 c.c. (ʒii$\frac{1}{2}$) doses of camphor oil. This treatment is based upon the fact that camphor checks the growth of the Pneumococcus, the bacterium which causes pneumonia. It is then supposed to act as a specific in pneumonia, and at the same time to strengthen the heart action.

Preparations

Solid Preparations

Camphor (Camphora)	0.1–0.6 gm.	grs. ii–x
Monobromated Camphor (Camphora Monobramata)	0.12–1.0 gm.	grs. ii–xv

This is occasionally used to relieve nervousness, hysteria, and sexual excitement.

Fluid Preparations

Camphor Water (Aqua Camphorae) (Strength 1–125)	4.0–10.0 c.c.	ʒi–ii½
Spirit of Camphor (Spiritus Camphorae) (Strength 10%)	0.3–2.0 c.c.	m. v –xxx

This is much stronger than the camphor water.

Camphor Oil (Oleum Camphorae)	0.3–0.6 c.c.	m. v–x

This is the crude oil itself and rarely used.

Camphor Liniment or Camphorated Oil (Linimentum Camphorae)	2.0 c.c.	m. xxx

This is a 20% solution of camphor in cottonseed oil. It is used locally to relieve pain.

It is extensively used, however, for hypodermic use as a heart stimulant; and in doses of 10 c.c. in the treatment of pneumonia. It should always be injected deeply into the muscles.

Soap Liniment (Linimentum Saponis)

This contains about 5% of camphor, 6% of soap, 70% of alcohol, and oil of rosemary. It is used locally to relieve pain.

AMMONIUM

Ammonium is a solution of ammonia gas in water. Ammonia is a combination of one part of nitrogen gas and three parts of hydrogen gas and is a strong alkali. It is formed when animal matter decays.

Appearance of the Patient

When ammonia gas is inhaled, it causes redness of the conjunctiva of the eye, a profuse flow of tears, a flow of mucus

from the nose, and sneezing; due to the red and swollen condition of the mucous membranes.

It also causes severe coughing with excessive secretion of mucus from the bronchi, due to the irritation of their lining membrane. The pulse is stronger and faster, and the breathing is deeper and more rapid.

These effects appear almost immediately, but last for a very short time.

ACTION

Local action: A weak solution of ammonia makes the skin red and soft. The skin feels slippery, as if it were covered with soap. Stronger solutions, if kept in contact with the skin and prevented from evaporating, form blisters (vesicant action), often destroying the skin (escharotic action).

On mucous membranes: It causes a red and swollen condition, with profuse secretion of mucus. The same destructive action as on the skin, results if it is allowed to remain in contact with the mucous membrane. On the conjunctiva, this results in a profuse flow of tears. In the nose, a profuse flow of mucus and sneezing. **In the bronchi:** When inhaled, or when given internally, it causes an excessive secretion of mucus which is somewhat more fluid in character.

Internal Action

In the mouth: Ammonia has a pungent taste, it reddens and slightly swells the lining membrane, and increases the flow of saliva.

In the stomach: It irritates the mucous membrane and neutralizes the hydrochloric acid of the gastric juice, lessening the digestion of food.

Action after Absorption

When ammonia is absorbed from the lining membrane of the stomach, it produces no effects; because it is changed at once to urea, one of the constituents of the urine. It therefore increases the amount of urea in the urine.

Ammonia is usually given by inhalation and it produces its best effects in this manner; they are not very lasting however. When given by mouth, the same but more lasting effects are produced. The drug is absorbed from the stomach in the form of ammonium chloride, which is formed by the combination with the hydrochloric acid in the stomach.

Ammonia affects principally the heart and the respiration.

Action on the heart: It makes the heart beat stronger and faster, causing a strong and rapid pulse.

Action on the respiration: It makes the breathing more rapid and deeper.

These effects are not due to absorption of the drug, but to the red and swollen condition (irritation) of the mucous membrane of the eyes, nose and bronchi. This irritation affects the nerve endings in these mucous membranes, causing them to send impulses to the medulla of the brain. The medulla immediately responds to these impulses by sending impulses to make the heart beat stronger and faster, and to increase the depth and frequency of the breathing (reflex action). When given by inhalation these effects appear almost immediately, but last for a very short time.

When given by the mouth, the same but more lasting effects are produced, in a similar manner. They are due to the reflex action resulting from the irritation of the mucous membrane of the stomach.

Excretion

Ammonia is excreted as urea, a normal ingredient of the urine. The urine therefore contains a larger amount of urea. Ammonia is also excreted by the resulting profuse secretion of the mucous membrane of the bronchi.

Poisonous Effects

Acute Ammonia Poisoning

When a strong solution of ammonia is taken, the following symptoms result almost immediately:

The patient complains of **severe burning pain in the mouth.**

throat and stomach. The lips, mouth, throat, oesophagus and larynx are inflamed and swollen. Often the superficial tissues of these organs are destroyed. The **swelling of the larynx** may be so severe as to **obstruct the breathing** and the patient may **choke to death** because he is unable to get air into his lungs.

In addition to these symptoms, the patient feels **nauseated,** and **vomits profusely.** The vomited matter contains blood and pieces of the mucous membrane of the stomach.

The continual vomiting and the destruction of the lining membrane of the stomach cause the symptoms of **collapse:** pale, cold moist skin; rapid, weak, thready pulse; slow, shallow breathing; finally stupor, coma and death. Death may result in a few minutes from asphyxia, or later from **collapse.**

If the patient recovers, the **resulting scars** which form in the oesophagus from the destruction of the tissues, may cause **stricture** (a narrow condition) **of the oesophagus.** This may cause starvation from inability to swallow food.

Treatment

1. Neutralize the ammonia with dilute acids, that are not themselves injurious. Vinegar and lemon juice are the best acids to use.

2. Protect the lining membrane of the oesophagus and stomach with milk, oils, albumin water and other protecting drinks.

3. The collapse is usually treated with heart stimulants, such as caffeine, atropine and strychnine.

4. Do **not** keep the patient warm; as heat increases the action of ammonia. Apply cold applications to the head and give plenty of cold air.

5. If the patient suffers from asphyxia, incising the trachea (tracheotomy) may save the patient's life.

6. For the resulting stenosis of the oesophagus, bougies are passed, or surgical interference may be necessary.

Uses

Ammonia is used for the following conditions:

1. As a heart stimulant for temporary effect, for example in fainting.
2. In the form of liniments, to relieve pain.
3. To neutralize the acid of the gastric juice.
4. To check the formation of gas in the stomach.
5. To increase the cough and expectoration.

Preparations

Fluid Preparations

Strong Ammonia Water
(Aqua Ammoniae Fortior)

This contains about 28% of ammonia gas. It is never given internally. It is used locally, applied to snake bites and to form a blister to withdraw fluid from the deeper tissues.

Ammonia Water **0.6–2.0 c.c.** **m. x–xxx**
(Aqua Ammoniae)

This contains 10% of ammonia gas.

Aromatic Spirit of Ammonia 2.0–4.0 c.c. ʒ½–i
(Spiritus Ammoniae Aromaticus)

This contains ammonia water and 4% of ammonium carbonate, together with the oil of nutmeg, oil of lemon and oil of lavender.

It is used principally to overcome fainting, as a carminative, and to relieve nausea.

Solution of Ammonium Acetate 4.0–16.0 c.c. ʒi–iv
(Liquor Ammonii Acetatis)
(Spirit of Mindererus)

This is used principally to increase sweating (diaphoretic) and to increase the flow of urine (diuretic).

For Local Use

Ammonia Liniment
(Linimentum Ammoniae)

This is a 3½% solution of ammonia in alcohol and cottonseed oil.

Solid Preparations

Ammonium Carbonate (Ammonii Carbonas)	0.3–0.6 gm.	grs. v–x

This is used as a heart stimulant and as an expectorant.

Ammonium Chloride (Ammonii Chloridum)	0.3–1.3 gm.	grs. v–xx

This is used principally as an expectorant (see page 267.)

There are numerous other salts of ammonium, such as ammonium bromide, ammonium iodide, etc. They are used principally for the effect of the bromide, iodide, etc. The combination with ammonium, however, may strengthen the heart action.

OTHER HEART STIMULANTS

The following drugs are used extensively as heart stimulants. Their general action will be considered later.

ATROPINE

Atropine makes the heart beat stronger and faster. It paralyzes the nerve endings in the heart, of the Vagus or inhibitory nerves, which carry impulses to make the heart beat slower. When the nerve endings of these nerves are paralyzed, these impulses are cut off. The heart therefore beats stronger and faster; consequently **the pulse, after atropine, is stronger and faster.**

For other actions and preparations, see page 410.

STRYCHNINE

Strychnine makes the heart beat slower and stronger. It causes the medulla of the brain to send impulses along the Vagus or inhibitory nerves, to make the heart beat slower. It also contracts the blood vessels, and by thus offering greater resistance to the heart, makes the heart beat stronger. **The pulse is therefore slower and stronger after strychnine.**

For other actions and preparations, see page 296.

CAFFEINE

Caffeine is used in cases of collapse to improve the character of the pulse and breathing. It causes an evanescent rapid, perhaps stronger pulse. This is the result of the action of caffeine on the brain and medulla. The greater number of impulses sent from the vaso constrictor center of the medulla cause slight contractions of the small muscle fibers in the walls of the blood vessels which make the blood vessels narrower and thus temporarily improve the character of the pulse.

ALCOHOL

Alcoholic liquors make the heart beat stronger and faster. Because the blood vessels are widened (dilated) the pulse has a bounding quality; since the contractions and relaxations of the heart can be more easily transmitted along the wider blood vessels.

The pulse after alcohol is therefore strong, fast and bounding. The effects last only for a very short time, however, and are the result of the local irritation of the mucous membrane in the mouth or at the site of injection. For hypodermic use, whiskey is the preparation commonly used.

For other actions and preparations, see page 330.

MUSK

Musk is occasionally used as a heart stimulant. It is very expensive and very unreliable. When its effects *are* produced, it makes the heart beat stronger and faster. The pulse is therefore stronger and faster. The effects wear off very quickly.

For other actions and preparations, see page 394.

VASO CONSTRICTORS

(Drugs which Contract the Blood Vessels)

EPINEPHRINE (ADRENALIN)

Epinephrine is an extract containing all the active principles, of the suprarenal or adrenal glands of the sheep or ox.

The adrenal gland is a small pyramidal gland situated immediately above the kidney.

Appearance of the Patient

After an intravenous or hypodermic injection of epinephrine, the following effects are noticed within 15 or 20 minutes after it is given:

The skin becomes pale, all the visible mucous membranes, such as the lips and conjunctiva become pale and blanched. The pupils are dilated. There is an excessive secretion of saliva and mucus in the mouth.

The pulse is slow, strong, and tense; the blood pressure being greatly increased, so that it is difficult to obliterate the pulse by pressure with the finger. The breathing is somewhat deeper. These effects wear off in an hour.

ACTION

Local action: Applied to the skin, epinephrine has no action. If applied to a bleeding point, it checks the bleeding by contracting the blood vessels. **On mucous membranes:** It makes the mucous membranes pale by contraction of the underlying blood vessels. For example—if applied to the **conjunctiva of the eye,** epinephrine makes it pale, it widens the eyelids, dilates the pupils and slightly protrudes the eyeball. **In the nose:** It makes the mucous membrane pale and contracted, and thereby widens the nasal cavities.

Internal Action

In the mouth: Epinephrine contracts the mucous membrane, from which it may be slightly absorbed.

Since epinephrine is an extract of a gland (an organ of the body), it is digested by the gastric juice of the stomach. It therefore produces no general effects when given by the mouth. To obtain its effects, it must be given either intravenously, intramuscularly or hypodermically.

Action after Absorption

When given intravenously, the effects appear in about

five to ten minutes. When given intramuscularly or hypodermically, the effects appear within a half hour.

After absorption, epinephrine affects principally the blood vessels, the heart, the involuntary muscles, the pupils and secretory glands.

Action on the blood vessels: This is the most important effect of epinephrine. It makes all the small blood vessels, especially the small arteries, narrower by contraction of the small muscle fibers in their walls. The blood vessels in the abdomen are contracted most of all, those in the brain and lungs least. The coronary vessels in the heart are dilated, however. By the contraction of the blood vessels it greatly **increases the blood pressure** (the pressure of the blood in the blood vessels). It is the best drug for increasing the blood pressure.

The narrower blood vessels offer a greater resistance for the heart, thus increasing the force of its contractions.

The increase in blood pressure causes impulses to be sent to the Vagus center in the medulla, to which it responds by sending impulses to slow the heart (in a reflex manner).

Action on the heart: Epinephrine makes the heart beat slower and stronger:

This results from the following effects:

1. The increased contractions of the heart muscle (increased tone and contractility).
2. The contractions of the blood vessels.
3. The increase in blood pressure which makes the heart beat slower.

The total effect of epinephrine on the circulation is, therefore:

Slow, strong contractions of the heart with greatly increased blood pressure, which make **the pulse slow, strong, and tense.**

Action on involuntary muscles: Epinephrine increases the contractions of the involuntary muscles of the uterus, and its blood vessels.

The involuntary muscles of the **stomach** and **intestines** are **relaxed;** though the blood vessels in their walls are con-

tracted. **Action on the Pupil:** The pupil of the eye is widened (dilated) by contraction of the radial fibers of the iris, or colored part of the eye.

Action on the secretory glands: The secretions of all the secretory glands, except the sweat glands and the pancreas, are increased by epinephrine. This effect is produced by making the nerve endings in the glands more sensitive to stimuli. As a result of this action, they receive more impulses, which make the glands secrete more profusely.

Epinephrine therefore increases the flow of saliva, mucus in the mouth, the flow of tears and bile.

The secretion of the sweat and pancreatic juice is not increased. It often causes sugar in the urine (glycosuria).

The effect of epinephrine wears off very quickly; usually in about 15 minutes to an hour.

Excretion

Epinephrine is mostly destroyed in the body. Part of it, however, is eliminated by the kidneys in about an hour or two.

Poisonous Effects

Overdoses of epinephrine cause the following symptoms:

1. Slow irregular pulse.
2. Pale, blanched skin.
3. Dilated pupils.

From still larger doses the following symptoms will also occur:

1. Rapid, weak, thready pulse.
2. Collapse: Pale, cold, moist skin, slow and shallow breathing, and dilated pupils.

A single overdose may cause such profound collapse, that death may result.

Uses

Epinephrine is used for the following conditions:

1. **To check bleeding** by contracting the bleeding vessels. It is only of value in bleeding from the small blood vessels. The bleeding may start up again, however, when the effect

of the drug wears off, because after the blood vessels are contracted, they soon dilate again.

In bleeding from the nose, stomach, intestines, uterus or bladder, epinephrine is very valuable, if it can be applied to the bleeding spot without the necessity of an elaborate surgical procedure.

2. **As a heart stimulant,** especially where a rapid effect is desired. The effect soon wears off, however.

3. Epinephrine is often used together with cocaine. It contracts the blood vessels, lessening the absorption of the cocaine, which is then less apt to cause poisonous effects.

4. In the treatment of Addison's disease (tuberculosis or cancer of the adrenal glands). It then supplies the absent secretion of the adrenal glands.

Preparations

Dried Suprarenal Glands (Glandulae Suprarenales Siccae)	0.25 gm.	grs. iv

The powdered dried suprarenal glands of the sheep or ox.

Epinephrine Chloride (1–1000 solution)	0.3–1.0 c.c.	m. v–xv
Adrenalin Chloride Solution	0.3–1.0 c.c.	m. v–xv

This is a 1–1000 solution of adrenalin chloride, the active principle of the suprarenal glands, in normal salt solution.

Adrenalin Inhalant

This is a 1–1000 solution of adrenalin chloride in oil.

Adrenalin Ointment

An ointment of adrenalin chloride 1–1000 in strength.

Adrenalin Suppositories

A 1–1000 solution of adrenalin chloride in cocoa butter.

Adrenalin Tablets

Each tablet contains 0.001 gm. (gr. $\frac{1}{200}$) of adrenalin

borate. Each tablet when dissolved in 1.0 c.c. (m. xv) of water, makes a 1–1000 solution.

Adrenalin is a patented name for epinephrine. There are other preparations of epinephrine, made by other firms under various names, such as:

Adnephrin
Suprarenalin
Suprarenin
Supracapsulin

The preparations of these are the same as those of adrenalin. **L. Suprarenin Synthetic** is an artificial preparation of adrenalin.

Administration

Epinephrine is given intravenously, intramuscularly, or hypodermically. When it is given intravenously, it must be injected very slowly, to avoid poisonous effects.

For local effect, it is used in 1–15000 to 1–1000 solutions, preferably in oil.

PITUITARY EXTRACT (PITUITRIN)

Pituitary extract is a substance made from the posterior part of the pituitary gland. This is a small gland situated at the base of the brain.

ACTION

The following are the principal effects of pituitary extract; they are similar to those of epinephrine.

1. Pituitary extract makes the heart beat slower and stronger by directly affecting the heart muscle.

2. It makes the blood vessels narrower by contracting the small muscle fibers in their walls. It therefore greatly increases the blood pressure. This effect appears slowly but is more prolonged than that of epinephrine. The blood vessels of the kidney are the only ones that are dilated.

3. It increases the contractions of the uterus.

4. It contracts all involuntary muscles. It increases peristalsis; thus helping to expel gas from the intestines.

5. It may relieve many of the symptoms due to deficient function of the posterior lobe of the pituitary gland in the brain (Hypopituitarism). (See page 548.)

It is used principally to increase uterine contractions and hasten labor. It is also used as a heart stimulant to increase the blood pressure in infectious diseases such as pneumonia, etc., and to expel gas from the intestines.

Preparations

Pituitary Extract	1.0 c.c.	m. xv
Pituitrin	1.0 c.c.	m. xv

ERGOTOXINE

This is the active principle of Ergot. It contracts the blood vessels and increases the blood pressure.

Table of Circulatory Stimulants

Drugs acting rapidly. Suitable for immediate effect.	Drugs acting slowly. Suitable for continuous effect.	Drugs causing a rapid pulse.	Drugs causing a slow pulse.	Drugs whose effects wear off quickly.	Drugs which raise the blood pressure.
Caffeine	Digitalis	Caffeine	Digitalis	Caffeine	Epinephrine
Strychnine	Strophantus	Atropine	Strychnine	Epinephrine	Pituitary Extract
Atropine	Squills	Ammonium	Epinephrine	Ammonium	Ergotoxine
Camphor	Convallaria	Alcohol	Pituitary Extract	Alcohol	
Epinephrine	Apocynum	Camphor (sometimes)	Camphor (sometimes)	Musk	
Pituitary Extract	Adonis Vernalis	Musk	Strophantus		
Ammonium			Squills		
Alcohol			Convallaria		
Digalen			Apocynum		
Digipuratum (ampoules)			Adonis Vernalis		
Musk					

CHAPTER XIII

CIRCULATORY DEPRESSANTS

The most important effect of the following group of drugs is to lessen the action of the heart. (See page 217 for heart depression.)

ACONITE (MONK'S HOOD OR WOLFSBANE)

Aconite is obtained from the root of **Aconitum napellus,** monk's hood or wolfsbane, a perennial plant growing in the mountainous regions of Europe and Asia. The root often resembles horse-radish in appearance. The active principle of aconite is the alkaloid, **aconitine.** There are several other species of aconite which contain several similar alkaloids such as pseudaconitine and japaconitine, which produce the same effects as aconitine.

Appearance of the Patient

When an average dose of aconite is given, the patient's mouth and throat feel warm, and he often complains of slight numbness and tingling of the lips, tongue and throat, or even in the extremities. The pulse is slower and somewhat weaker, and the breathing is usually slow and shallow. The temperature is lowered and the patient often feels quite weak.

ACTION

Local action: Applied to the skin or mucous membranes, aconite or aconitine causes a prickling or tingling sensation. This is due to the greater sensitiveness of the nerve endings in the skin or mucous membranes. The ordinary sensations of touch are then felt as prickling or tingling sensations. Soon, however, these nerve endings are paralyzed, and the skin or mucous membranes feel numb. Very often this increased sensitiveness causes various reflex actions. For

example—when aconite is applied to the mucous membrane of the nose, it causes sneezing. Increased flow of saliva, vomiting and coughing also often result in a reflex manner, from the local application of aconite to mucous membranes.

Internal Action

In the mouth: Aconite has a bitter taste and causes a prickling and tingling sensation followed by numbness in the mouth and throat. This effect on the nerve endings in the mouth, causes a reflex flow of saliva. Later the secretions are checked and the mouth feels dry.

In the stomach and intestines: In the doses that aconite is usually given, it produces no effect. In larger doses, however, it often causes nausea and vomiting by the reflex contractions of the muscles of the stomach and intestines, as a result of the greater sensitiveness of their nerve endings.

Action after Absorption

Aconite is absorbed into the blood stream through the lining membrane of the stomach, usually in about half an hour after it is given. After absorption, it acts principally upon the heart, the respiration, the nerve endings and the temperature.

Action on the heart: Aconite makes the heart beat slower and weaker, and lessens the blood pressure. The effect on the heart is due to the increased number of impulses which are sent to the heart from the cardio-inhibitory center in the medulla of the brain, along the Vagus or inhibitory nerves.

The pulse of aconite is usually slow, weak, soft and compressible.

Action on the respiration: Moderate doses of aconite increase the breathing, but large doses make the breathing slower and labored.

Action on the nervous system: Aconite does not act on the brain, but it produces important effects as a result of its action on the nerve endings.

Action on the nerve endings: When taken internally, or when applied locally, aconite makes the sensory nerve endings of the skin and mucous membranes more sensitive at

first, and later paralyzes them. This produces the tingling and prickling sensations, followed by numbness, which are so characteristic of aconite.

The muscular weakness produced by aconite in large doses, is due to its effect on the nerve endings in the muscles.

Action on the secretory glands: Aconite increases the secretion of sweat and saliva, by making the nerve endings in the mouth and skin more sensitive, thus reflexly increasing the secretions.

Effect on temperature: It reduces temperature by increasing the elimination of heat.

Excretion

Aconite is eliminated from the body in about three or four hours after it is given, mainly by the urine.

Poisonous Effects

Since aconite is rapidly excreted, only acute aconite poisoning occurs, usually from the administration of an overdose.

Aconite is one of the few poisons which cause death very rapidly. If a sufficiently large dose is taken, the patient may die immediately, from sudden paralysis of the heart. Usually, however, the symptoms appear very rapidly and the patient dies in about three or four hours.

Symptoms

The first, and diagnostic symptom of aconite poisoning is:

The characteristic tingling and prickling sensation on the lips, mouth and throat, and a smarting, tingling feeling of the skin of the extremities, **soon followed by numbness.** Later this sensation passes over the entire body.

2. Profuse flow of saliva.
3. Nausea and vomiting.
4. Great muscular weakness.

5. Slow, irregular, weak pulse.

6. Slow, shallow, difficult, irregular breathing.

7. Collapse (cold, moist skin; anxious face; protruding eyeballs with dilated pupils; rapid, thready, very weak pulse).

8. Often there are convulsions and unconsciousness just before death. Usually however, consciousness remains to the last. Death usually results from paralysis of the respiration.

Treatment

To save a patient from aconite poisoning, quick action is necessary, as death results very rapidly.

1. Wash out the stomach.

2. **Atropine is given as an antidote.**

This prevents the slow weak heart action, by paralyzing the nerve endings in the heart, of the Vagus nerve, and it also makes the breathing faster and deeper.

3. Keep the patient absolutely quiet, flat on his back, lower the head by removing the pillows, and elevate the foot of the bed.

4. Give artificial respiration.

5. Heart stimulants such as caffeine, whiskey, ammonia, are usually given.

Uses

Aconite is now rarely used. It is principally given to reduce fever in acute infectious diseases.

Preparations

Fluidextract of Aconite (Fluidextractum Aconiti) 0.06–0.12 c.c. m. $\frac{1}{2}$–ii

Tincture of Aconite (Tinctura Aconiti) 0.06–0.3 c.c. **m. i–v**

This is the preparation commonly used.

For Local Use

Aconite Liniment (not official) (Linimentum Aconiti)

This contains about 2% of aconite, and is an ingredient

of many patent medicines which are used to relieve the pains of chronic rheumatism.

Aconite Ointment (not official)
(Unguentum Aconiti)

This contains 2% of aconite.

Aconinite

Aconitine 0.00015–0.0006 gm. gr. $\frac{1}{400}$–$\frac{1}{100}$
(Aconitina)

STAPHISAGRIA (STAVESACRE OR DELPHINIUM)

Staphisagria or stavesacre is obtained from the dried ripe seeds of **Delphinium staphisagria** or stavesacre.

Its active principle is an alkaloid, **delphinine**, which produces the same effects as Aconitine.

Delphinine is used in the form of a tincture or ointment to destroy parasites, such as lice.

VERATRUM (AMERICAN HELLEBORE)

Veratrum is obtained from the root and underground stems of the **Veratrum viride**, or green hellebore, a plant which grows in swampy places in the northern part of the United States. It is commonly known as American or swamp hellebore, or Indian poke. There is also another species of veratrum known as **Veratrum album**, or white hellebore.

The active principles of veratrum are the alkaloids, **cevadine** and **veratrine**. These alkaloids are very closely related to aconitine chemically, and they produce very similar effects.

ACTION

The following are the principal effects of veratrum. They resemble those of aconite but they differ in several instances:

1. Locally veratrum is very irritating to the skin and mucous membrane but is soon followed by a local soothing effect. It causes profuse sneezing and coughing when inhaled.

2. It frequently causes nausea and vomiting.

3. It makes the heart beat slower and weaker, by increasing the impulses sent to it through the Vagus nerves, thus causing a slow soft pulse.

4. It lowers the blood pressure.

5. It slightly increases the contraction of muscles but it markedly prolongs the period of relaxation. This is a very characteristic effect of veratrum and is often spoken of as "veratrine effect."

Veratrum is used principally to lower blood pressure in eclampsia, a condition of poisoning occuring in pregnancy.

Preparations

Fluidextract of Veratrum (Fluidextractum Veratri)	0.06–0.3 c.c.	m. i–v
Tincture of Veratrum (Tinctura Veratri)	0.3–1.0 c.c.	m. v–xv

VERATRINE

Veratrine is a mixture of all the alkaloids found in **Veratrum sabadilla,** or **Asagraea officinalis,** a Mexican plant known as cevadilla. The most important of these alkaloids are **veratrine** and **cevadine,** which are also found in veratrum viride.

It produces the same effects as veratrum.

It is used principally to relieve pain in neuralgia, rheumatism, etc.

Preparations

Veratrine Ointment (Unguentum Veratrinae)

This contains 4% of veratrine.

Oleate of Veratrine (Oleatum Veratrinae)

This contains 2% of veratrine.

Other Heart Depressants

The following drugs also lessen the heart action, but they have other more important effects under which they will be described.

They cause slow, weak contractions of the heart, producing a slow, weak pulse.

Eserine or Physostigmine
Pilocarpine
Grindelia
Lobelia
Dilute Hydrocyanic Acid

VASO-DILATORS

(Drugs which Dilate the Blood Vessels)

The following drugs act principally on the blood vessels. They lessen the contractions of the small muscle fibers in their walls, so that the blood vessels are widened. As a result of this action, various effects are produced upon various organs and tissues of the body.

THE NITRITES

The nitrites are salts formed by the combination of nitrous acid with an alkali, or an organic substance such as an alcohol, as amylic alcohol. The most important compounds formed in this way, are **amyl nitrite** and **nitroglycerine.** Amyl nitrite produces rapid effects which soon pass off, and nitroglycerine produces slower effects which are more lasting.

AMYL NITRITE

Amyl nitrite is a yellow fluid which evaporates easily, and has a characteristic odor of fruit. It is made by distilling nitric acid with amylic alcohol, sulphuric acid and copper, and then purifying the resulting liquid.

Appearance of the Patient

About three to five minutes after an average dose of amyl nitrite is inhaled, the face becomes flushed, and sometimes

the skin all over the body as well. The patient complains of fullness and throbbing in the head, and often of severe headache. The pulse is rapid, soft and bounding, and the breathing is rapid and somewhat deeper. These symptoms last for about ten to fifteen minutes, and then pass off.

Administration

Amyl nitrite is usually given by inhalation. It comes in small glass "pearls," each containing about 0.2–0.3 c.c. (m. iii–v) of amyl nitrite, which are broken in a handkerchief and then applied to the nose of the patient. The handkerchief should be withdrawn as soon as the effects are produced. Amyl nitrite is occasionally given hypodermically. It is also given by the mouth; about 0.2–0.3 c.c. (m. iii–v) dropped on a piece of sugar; but the effects then appear very slowly.

Uses

Amyl nitrite is used for the following effects:

1. To relieve an attack of "angina pectoris," a disease characterized by attacks of severe pain around the heart, and shooting pains into the left arm. This disease is due to the spasmodic contractions of the muscle wall of the coronary arteries in the heart, (the vessels which supply the heart muscle with blood). Amyl nitrite relieves these attacks by relaxing the spasms of these blood vessels.

2. To relieve an attack of bronchial asthma; by relaxing the spasm of the involuntary muscles in the walls of the bronchi.

Preparations

Amyl Nitrite (Amylis Nitris)	0.15–0.3 c.c.	m. ii–v

This comes in small glass capsules (pearls) each containing the required dose. It should always be fresh; as it decomposes very easily.

ACTION OF THE NITRITES

Appearance of the Patient

The effects that result from the use of the nitrites are the same as those following amyl nitrite, but they appear very slowly.

ACTION

In the mouth: Nitroglycerine has a pungent taste.

In the stomach: All the nitrites with the exception of nitroglycerine, may cause nausea and vomiting.

Action after Absorption

The nitrites are very rapidly absorbed into the blood, through the lining membrane of the stomach. After absorption, they affect principally the blood vessels, the respiration and the kidneys.

Action on the circulation: The nitrites do not affect the heart directly, but by means of their action on the blood vessels.

Action on the blood vessels: The nitrites affect principally the blood vessels. They paralyze the small involuntary muscle fibers in the walls of the small blood vessels. As a result, these blood vessels are widened, so that it is easier for the blood to pass through them, and the blood pressure is lessened. The heart does not then have to contract so forcibly, because the blood moves along more freely, and it does not need much propelling force, since the blood vessels are wider. The heart contracts faster, however, because the wider blood vessels offer very little resistance to the contractions of the heart, which then contracts with greater ease. By the action on the blood vessels, the nitrites ease the action of the heart, when it is overworking because of increased blood pressure, or because of spasmodic contractions of the blood vessels.

The blood vessels of the abdomen and head are more affected than those of the extremities.

The total effect of the nitrites on the circulation is to

make the heart beat faster, and to lower the blood pressure. Consequently the pulse is rapid, soft and bounding.

Action on the respiration: The nitrites make the breathing faster and deeper.

Action on the nervous system: The nitrites do not affect the nervous system directly. The headache, the fullness in the head and the occasional dizziness, are due to the dilated blood vessels in the brain, which then contains more blood (congestion), as a result of which these sensations are produced.

Effect on temperature: The temperature is somewhat lowered.

Action on the kidneys: The flow of urine is often increased by the nitrites, when the kidneys do not secrete a sufficient amount of urine, because of the high blood pressure. The better circulation of blood in the kidneys as a result of the widened blood vessels, increases the secretion of urine.

Excretion

The nitrites are excreted by the urine, usually in about one or two hours.

Poisonous Effects

Poisonous symptoms usually occur suddenly from the inhalation of an overdose of amyl nitrite. After prolonged administration of the other nitrites the same symptoms occur but more gradually.

Symptoms

1. Flushing of the face and neck.
2. Intense throbbing headache (a feeling of a tight band around the head or as if the "head were coming off").

These symptoms frequently occur from an ordinary dose of amyl nitrite but soon pass off. Occasionally from a single dose of amyl nitrite, and from continued use of other nitrites the following symptoms may also occur:

3. Faintness.
4. Dizziness.
5. Dilated pupils.
6. Slow, irregular pulse.
7. Confusion of ideas.
8. Collapse.

The symptoms usually improve when the patient is lying down or when the drug is stopped.

Administration

The nitrites should be given in a wineglassful of milk after meals. If tablets are used these should be dissolved in the milk.

Uses

The nitrites are given principally in repeated doses for a long time, in the following conditions:

1. **Arteriosclerosis,** or hardening of the arteries.

It relaxes the contractions of the arteries whose muscle fibers have not yet been replaced by connective tissue. In many cases nitroglycerine produces no effect, as the muscle fibers have been replaced by fibrous tissue, which is not elastic.

2. To reduce blood pressure, in nephritis.

3. To relax the contractions of the involuntary muscles in the bronchi, in asthma.

4. To prevent the attacks of angina pectoris by keeping the muscles of the coronary blood vessels of the heart relaxed.

NITROGLYCERINE

Nitroglycerine or spirits of glonoin, is a colorless, oily liquid which has an odor and taste like alcohol. Nitroglycerine combined with porous silica forms dynamite. Preparations of nitroglycerine should be very carefully handled, as it is apt to explode when dropped on the floor, when heated, or when rubbed vigorously. If it is accidentally spilled, it should be destroyed immediately, by pouring potassium hydroxide solution over it.

A 1% alcoholic solution is used as a medicine, which should always be kept cool, as it may explode when exposed to heat.

Preparations

Spirits of Glyceryl Trinitrate (**Spiritus Glycerylis Nitratis**) **Nitroglycerin or Spirits of Glonoin** 0.03–0.2 c.c. m. ½–iii

This is a 1% alcoholic solution of nitroglycerine. It should always be fresh, as it decomposes very easily.

Tablets of Nitroglycerine (Tabellae Trinitrini) (not official)	0.0006 gm.	gr. $\frac{1}{100}$

1 to 2 tablets are given at a time.

These are not as efficient as a solution of the drug, and they decompose very easily.

SODIUM AND POTASSIUM NITRITES

Sodium and potassium nitrites are salts formed by the combination of sodium or potassium, with nitrous acid.

They produce the same effects as amyl nitrite or nitroglycerine, with the following variations:

1. Their effects appear very slowly, usually in about a half hour, but they last for several hours.
2. They often cause nausea, belching of gas, and pain in the stomach, and occasionally diarrhoea.
3. They do not cause as much headache, or flushing of the face as amyl nitrite or nitroglycerine does.

Uses

The nitrite of either sodium or potassium, is suitable for continued use, to lower the blood pressure.

Preparations

Sodium Nitrite (Sodii Nitris)	0.06–0.12 gm.	grs. i–ii

This is given in solution or in tablets.

Potassium Nitrate (Potassii Nitras)	0.06–0.5 gm.	grs. i–viii

This is not official and is rarely used.

New and Non-official Preparations of the Nitrites

Erythrol Tetranitrate (Tetranitrol)	0.03–0.06 gm.	gr. $\frac{1}{2}$–i
Mannitol Hexanitrate	0.03–0.06 gm.	gr. $\frac{1}{2}$–i

These preparations are given in tablets, because they are explosive in fluid form.

These preparations produce the same effects as nitroglycerine, but the effects appear more gradually and are more lasting. The effects usually appear in about 15 minutes and last for about 3 or 4 hours.

SWEET SPIRIT OF NITER (SPIRITUS AETHERIS NITROSI)

Sweet spirit of niter is a 4% solution of nitrous ether, or ethyl nitrite, in alcohol. It evaporates very easily and is inflammable. It should always be fresh, as old solutions decompose.

ACTION

Sweet spirit of niter produces the same effects as nitroglycerine or the other nitrites.

It dilates the blood vessels by paralyzing their muscle fibers, and causes:

1. A rapid, soft, bounding pulse.
2. Rapid breathing.
3. Increased flow of urine, by relaxing the blood vessels of the kidneys.
4. Increased secretion of sweat, by widening the blood vessels of the skin, so that the sweat glands are supplied with more blood from which to secrete perspiration.

Poisonous Effects

Inhalation of sweet spirit of niter has produced dangerous, even fatal symptoms; resembling those produced by amyl nitrite.

Symptoms

1. Headache.
2. Pain around the heart.
3. Weak, slow pulse.
4. Slow, shallow breathing.
5. Muscular weakness.
6. Collapse.

Uses

Sweet spirit of niter is used to increase the sweat and thereby to reduce fever, especially in children. It is given in

small doses, well diluted; and the patient should be kept in bed, warmly covered. If the skin is kept cool, it increases the flow of urine

Spirit of Nitrous Ether (Spiritus Aetheris Nitrosi) Sweet Spirit of Niter	1.0–4.0 c.c.	$3\frac{1}{4}$–i

PART IV—DRUGS ACTING ON THE RESPIRATORY SYSTEM

CHAPTER XIV

DRUGS ACTING ON THE RESPIRATORY ORGANS

The Respiration

Breathing is an act whereby the lungs regularly inhale and exhale air about 18–20 times a minute. The mechanism of breathing consists of rhythmical alternate expansions and contractions of the lungs.

Respiration consists of two phases:

1. **Inspiration.**
2. **Expiration.**

The inspiration is the period during which the lung inhales air. It is caused by the downward movement of the diaphragm, and the separation of the ribs. This makes the chest wider, so that the lungs expand and inhale air.

The inspired air, which fills up the air sacs of the lungs, contains oxygen. This oxygen enters the blood, by passing through the walls of the air sacs into the capillaries of the lungs. It is then carried to the tissues and organs of the body by the circulation of the blood.

The expiration is the period when the lungs exhale air. This is caused by the contraction of the diaphragm, which then moves upward, the contractions of the intercostal muscles (the small muscles between the ribs) and by the elasticity of the lung tissue. As a result of the contractions of these muscles, the chest becomes narrower, the lungs therefore contract and expel the air which they contain. The expired air contains carbon dioxide gas, and other waste products which have been brought to the lungs by the impure blood from the various tissues and organs of the body.

Breathing is an automatic act: that is, it occurs inde-

pendently of all the influences produced by the other activities of the body.

The most important part of the act of breathing, is the action of the diaphragm, a flat dome-shaped muscle separating the chest from the abdomen. The contractions of this muscle are controlled by impulses sent from a spot of gray matter in the medulla of the brain, along two nerves, the Phrenic nerves, which go to this muscle. This spot of gray matter is called the respiratory center. It is often called the vital center, because when it ceases to send impulses for breathing, death ensues.

Death by hanging, or by the garotte (a method for executing criminals in Spain), is caused by the destruction of the respiratory center in the medulla of the brain.

The breathing can be modified, however, by impulses reaching the respiratory center along various nerves.

Impulses affecting the larynx or the bronchi may reach the respiratory center of the medulla, along the Vagus or inhibitory nerves (these nerves also send fibers to the larynx, bronchi and lungs as well as to the heart). These impulses may cause the respiratory center to send impulses to increase the depth and frequency of breathing (by reflex action). Impulses such as those produced by cold air, cold water, etc., that reach the respiratory center from the skin, also increase the depth and frequency of breathing.

Dyspnoea

When it is difficult for a patient to get air into the lungs, the breathing becomes deep and labored and is called **dyspnoea.** For example, when there is an obstruction to breathing, all the muscles attached to the chest, from the arms, neck and abdomen, contract forcibly. This makes the chest very much wider. The lungs therefore expand more than usual, thus making the inspiration much deeper. The contractions of the diaphragm and intercostal muscles are also increased; thereby making the chest much smaller with each expiration, so that more air is exhaled.

Dyspnoea is often caused when there is no obstruction to breathing, but when the blood is very impure, and contains

a great deal of carbon dioxide gas. This increases the impulses for breathing sent out from the medulla of the brain, thereby making the breathing deeper and more labored.

Apnoea

When the breathing is so slow and shallow that the movements of the chest can hardly be seen, it is called **apnoea.**

Cyanosis

Cyanosis is a blue color of the skin. This is caused by the dark color of the blood in the superficial blood vessels. This dark color is due to the methaemoglobin which the blood contains, as a result of an excess of carbon dioxide. It usually results when the patient does not get enough oxygen into the lungs to purify the blood.

Coughing

Coughing is a violent expiration preceded by a deep inspiration. When a patient coughs, there is a deep inspiration at first, followed by violent contractions of the abdominal muscles, which push the abdominal organs up against the diaphragm. The diaphragm then presses up against the lungs, and violently expels the air and secretions which they contain. The expiration is violent, because the larnyx is closed at the time when the expiration occurs.

Coughing is a reflex act. It occurs when an object lodges in the larynx, when the bronchi are red and inflamed, or when they contain a great deal of mucus. These affect the nerve endings in the bronchi, which send impulses along the Vagus nerves to the respiratory center in the medulla. This center at once sends back impulses to cause violent expiratory contractions of the diaphragm, and coughing results.

Drugs affect the respiration in two ways:

1. Increasing the breathing: **stimulation.**
2. Lessening the breathing: **depression.**

Respiratory Stimulation

When the respiration is stimulated, the breathing is usually deeper and faster. More air, and, therefore, more oxygen enters the lungs and then the blood.

Respiratory stimulation is produced in several ways.

1. By sending more impulses for breathing from the respiratory center of the medulla of the brain.

2. By causing redness, swelling and profuse secretion (irritation) of the mucous membrane of the bronchi, impulses are sent along the Vagus nerves to the respiratory center of the medulla. This center at once sends back impulses to make the breathing deeper and faster (reflex action).

3. By improving the condition of the blood, the medulla is supplied with better and purer nourishment. It is therefore better able to send out more impulses for breathing. The breathing is then deeper and faster. Tonics such as iron, and arsenic often improve the breathing in this way after prolonged use.

RESPIRATORY STIMULANTS

The following drugs are used as respiratory stimulants.

Atropine
Caffeine
Camphor
Strychnine
Alcohol
Ammonia

They make the breathing deeper and faster. They produce this effect by increasing the action of the respiratory center, so that more impulses for breathing are sent out from this center.

Their general action has already been considered, or will be considered later.

They are principally used in the treatment of collapse.

Atropine and **Caffeine** are the best known respiratory stimulants.

Strychnine is often used to increase coughing.

Ammonia is given by inhalation, usually in fainting.

ASPIDOSPERMA OR QUEBRACHO (not official)

Aspidosperma or quebracho, is obtained from the bark of the **Aspidosperma quebracho blanco,** a South American tree.

It increases the breathing by increasing the contraction of the diaphragm as a result of more impulses sent to it from the medulla. It also increases the secretions of mucous membranes, especially those of the bronchi.

It is used principally to relieve difficult breathing and as an expectorant to increase cough and fluidify the mucus.

Aspidospermine gr. $\frac{1}{60} - \frac{1}{30}$ is a mixture of all the active alkaloids and is the preparation used.

OXYGEN

Oxygen is a gas which forms 20% of ordinary air, and is necessary for the life of all animals. It is inhaled by the lungs with the inspired air. From the lungs, it enters the blood and combines with the haemoglobin of the red blood cells. These cells carry the oxygen to the various tissues and organs of the body, where it combines with some of the constituents of their cells, and thus enables the organs to carry on their various activities.

ACTION

Local action: Oxygen is a very good antiseptic, since most bacteria are unable to live in an atmosphere of pure oxygen.

Internal Action

When pure oxygen gas is inhaled, it enters the plasma of the blood, from the air sacs of the lungs. Some of the oxygen combines with the haemoglobin, forming oxyhaemoglobin, while part of it circulates uncombined, in the plasma. The formation of a greater amount of haemoglobin, gives the blood a brighter color, and the color of the skin then becomes more ruddy.

The improved condition of the blood **makes the breathing slower, and slows and strengthens the heart action.**

Uses

Oxygen is used in **pneumonia,** when the patient is blue and cyanotic, as a result of inability to obtain enough oxygen in the blood, because part of the lung is consolidated. The

oxygen inhalations often relieve this blue color, and make the breathing easier.

Oxygen is also given in **potassium chlorate, and in illuminating gas poisoning.** These drugs combine with the haemoglobin of the blood, and prevent it from taking up oxygen from the lungs. The oxygen given in such cases, enters the plasma in sufficient quantity to supply the tissues with nourishment until the haemoglobin is freed from the poisonous substance.

Administration

Oxygen should always be given continuously; inhaled through a mask from a tank along the bedside. The inhalations should be stopped when the symptoms disappear.

RESPIRATORY DEPRESSANTS

The following drugs make the breathing slower and shallower. They will be described later, under their more important effects.

Opium
Morphine
Codeine
Bromides
Chloral
Trional
Tetronal
Veronal
Sulphonal
Paraldehyde
Amylene hydrate and other similar hypnotics
Dilute Hydrocyanic Acid

OXAPHOR (not official)

Oxaphor is a 50% solution of oxycamphor, a derivative of camphor. Its principal effect is to make the breathing slow and shallow.

It is used as a substitute for morphine in asthma, and difficult breathing (dyspnoea) from other causes.

Oxaphor	2.0–3.0 gms.	grs. xxx–xlv

Expectorants may be divided into two groups: **Stimulating and Sedative Expectorants.**

The stimulating expectorants are used to increase the expectoration and the coughing (violent expiration). This effect is produced by the profuse, more fluid secretion of the mucous membrane of the bronchial tubes.

The excessive secretions of the bronchi, affect their nerve endings, thereby sending impulses along the Vagus nerves to the respiratory center in the medulla. This center at once sends back impulses to markedly increase the breathing, thus causing violent expiratory effects or coughing.

The sedative expectorants are used to relax spasms of the bronchial muscles and thus to relieve spasmodic cough.

STIMULATING EXPECTORANTS

AMMONIUM CHLORIDE (AMONII CHLORIDUM)

Ammonium chloride is an alkaline salt formed by the combination of ammonia and hydrochloric acid.

It is used principally to increase the cough and expectoration.

Poisonous doses cause the following symptoms:

1. Nausea and vomiting.
2. Bleeding from the mucous membranes.
3. Collapse.

Preparations

Ammonium Chloride (Amonii Chloridum)	0.3–1.0 gm.	grs. v–xv

Troches of Ammonium Chloride (Trochisci Amonii Chloride)

Each contains about 0.1 gm. (grs. ii) of ammonium chloride, with 0.25 gm. (grs. iv) of licorice extract, and some syrup of tolu.

Liquor Amonii Anisatus (Solution of Ammonia and Anise)

This is a preparation consisting of the following ingredients:

Oil of anise	1 part
Ammonia water	5 parts
Alcohol	24 parts

It is not official in this country, but it is extensively used, and is a very valuable preparation. It is an excellent stimulating expectorant and is given in doses of 0.6 to 2.0 gms. (m. x–xxx).

SENEGA (SNAKE ROOT)

Senega is obtained from the root of the **Polygala senega,** or **senega snake root,** a plant growing in the middle and southern United States.

Uses

Senega is used principally as a stimulating expectorant and somewhat as a diuretic.

Preparations

Fluidextract of Senega (Fluidextractum Senegae)	0.6–1.0 c.c.	m. x–xv
Syrup of Senega (Syrupus Senegae)	4.0–8.0 c.c.	ʒi–ii

Senega is also contained in the compound syrup of squills.

QUILLAJA (SOAP BARK)

Quillaja, panama bark or soap bark is obtained from the inner bark of the **Quillaja saponaria,** a South American tree which grows principally in Chili. Its active principles are saponins (soapy glucosides).

Uses

Quillaja is occasionally used as an expectorant and to cause vomiting. It is used by pharmacists to emulsify

(break up into fine globules) oils and other oily substances. It is largely used for cleaning silk and other fabrics.

TERPIN HYDRATE

Terpin hydrate is a colorless crystalline substance made from the oil of turpentine, by the action of nitric acid, alcohol and water.

Terpin hydrate is used principally as an expectorant, as an antiseptic in gonorrhoea, and in cystitis (inflammation of the bladder).

Preparations

Terpin Hydrate **Terpini Hydras**	0.06–0.25 gm.	grs. i–iv

BALSAM OF TOLU (BALSAMUM TOLUTANUM)

Balsam of tolu is a reddish yellow sticky semi-solid substance, which dissolves in alcohol, but not in water.

Its action is due to the benzoic acid which it contains.

It is used principally as an expectorant. It forms an ingredient of many cough mixtures.

Preparations

Balsam of Tolu **(Balsamum Tolutanum)**	0.06–0.3 gm.	grs. i–v
Syrup of Tolu **(Syrupus Tolutanus)**	15.0–30.0 c.c.	ʒ ½–i

SANGUINARIA (BLOOD ROOT)

Sanguinaria or blood root is obtained from the underground stems of the **Sanguinaria canadensis,** gathered in the autumn when its leaves are dead. It is used principally as an expectorant.

OTHER DRUGS USED AS EXPECTORANTS

Ipecac and Apomorphine in small doses are occasionally used to increase and fluidify the mucus.

Apocodein Hydrochloride 0.06 gm. gr. i
(Not official)

This is occasionally used as an expectorant.

SEDATIVE EXPECTORANTS

PRUNUS VIRGINIANA (WILD CHERRY)

Prunus Virginiana is obtained from the bark of the wild cherry tree.

Its active principles are **amygdalin**, a glucoside, and a ferment, **emulsin**. These two substances if rubbed together form prussic acid (hydrocyanic acid).

Prunus Virginiana is often given to increase expectoration and lessen coughing, together with other cough medicines.

Syrup of Prunus Virginiana (**Syrupus Pruni Virginianae**) 15% strength	4.0–15.0 c.c.	ʒi–iv

GLYCYRRHIZA (LICORICE ROOT)

Licorice forms an ingredient of many cough mixtures. It lessens coughing by protecting the mucous membrane of the throat and larynx and thus avoiding irritation. The following is the most commonly used preparation containing licorice:

Brown's Mixture (**Mistura Glycyrrhizae Compositus**)	2.0–10.0 c.c.	ʒ$\frac{1}{2}$–ii$\frac{1}{2}$

This mixture is a soothing cough mixture which also contains opium.

GRINDELIA

Grindelia is obtained from the leaves and flowers of **Grindelia robusta**, and **Grindelia squarrosa**, plants which grow on the western coast of the United States.

It is principally used to relieve spasmodic cough by relaxing the spasm of the involuntary muscles of the bronchial tubes.

LOBELIA

Lobelia or Indian tobacco, is occasionally used to relieve the spasmodic cough of whooping cough and asthma. It is a dangerous drug, and the patient should be carefully

watched when it is given. Its action will be described under its more important effects (see page 430).

Other Expectorants

The following drugs are also frequently used as expectorants. Their action has already been considered, or will be considered later.

Squills
Benzoin
Eucalpytus
Turpentine
Marrubium (horehound)
Serpentaria

PART V—DRUGS ACTING ON THE CENTRAL NERVOUS SYSTEM

A. DRUGS WHICH STIMULATE THE CENTRAL NERVOUS SYSTEM

CHAPTER XV

PHYSIOLOGY OF THE NERVOUS SYSTEM

The nervous system, or the cerebro-spinal system, consists of a number of organs which regulate the activities of all the other organs and tissues of the body.

The nervous system increases or diminishes the activities of the various organs of the body. It harmonizes the actions of one organ with those of another, and the activity of the body with its surroundings.

The nervous system consists of the brain, the spinal cord, the nerves, and nerve endings.

The brain

The brain is an organ situated in the skull. It consists of an outer part which has numerous folds, called convolutions. This outer part is of a gray color and consists of numerous microscopic cells.

The inner part of the brain is white in color, and consists of numerous microscopic fibers coming from, or going to, the cells in the gray matter.

The cells of the gray matter are the active parts of the brain.

The brain is divided into three parts:

1. **The Cerebrum**
2. **The Cerebellum**
3. **The Medulla Oblongata**

The **cerebrum** forms the largest part of the brain and is often called the fore brain.

The **cerebellum** is much smaller than the cerebrum, and

is situated immediately behind the cerebrum and is often called the hind brain.

The **medulla oblongata** joins the cerebrum to the spinal cord and is often called the mid brain.

Action of the Cerebrum

The cells of the gray matter of the cerebrum do three kinds of work:

1. **Sensory**
2. **Motor**
3. **Mental**

The **sensory work** of the brain consists of receiving impulses or messages from the various organs of the body.

The **motor work** of the brain consists of sending out impulses or messages to the various organs of the body.

The **mental work** of the brain consists of associating impulses and impressions received, or those sent out by one group of cells of the brain with the impressions of another group.

SENSORY ACTIVITY OF THE BRAIN, OR THE IMPULSES OR MESSAGES THAT ARE RECEIVED BY THE BRAIN

The body is kept constantly aware of its surroundings, and objects about it, by the impulses received through its various senses.

These impressions are received through the various senses. There are five kinds of sensory impressions received by the brain:

1. **Sense of Sight**
2. **Sense of Hearing**
3. **Sense of Smell**
4. **Sense of Taste**
5. **Sense of Touch**

Sight

The impressions received through the sense of sight are received through the eyes, which are complicated organs attached to the ends of nerves going to the brain, the optic nerves. Through the eyes, the brain learns the character of

various objects about it, their size, their shape and color. The body is thus able to avoid dangerous objects. It is also able to distinguish between light and darkness, and in this way we can tell the time of day, etc.

Hearing

The impressions of hearing are received through the ears, by means of nerves coming from the ears to the brain. Through the impulses of hearing, the body appreciates pleasant and unpleasant sounds. It is able to avoid dangers, and to respond to various impressions of sound, such as speech, music, etc.

Smell

Through the sense of smell the brain is able to appreciate pleasant and unpleasant odors by means of nerves coming from the nose to the brain, the olfactory nerves. Poisonous foods can thus be avoided, pleasant and unpleasant odors recognized, etc.

Taste

Through the sense of taste, palatable and unpalatable food substances are recognized, by means of impulses sent from the tongue to the brain along various nerves. The enjoyment of food is thus helped, and poisonous foods may be avoided.

Touch

The brain receives impressions through the sense of touch by means of numerous nerves which reach it either directly or through the spinal cord. The impressions are received by numerous nerve endings scattered over every part of the skin, from which they are carried along the various nerves to the brain or spinal cord.

Four different kinds of impressions are received by the nerve endings in the skin. Many of these sensations are received by special nerve endings, and reach the brain or spinal cord by separate nerve fibers.

1. **Sensation of touch:** This is a sensation whereby the consistency and shape of an object is determined by feeling it; whether it is hard, soft, smooth or rough; whether it is round, square, etc.

2. **Sensation of pain:** This is an unpleasant sensation, whereby the body is able to avoid injurious objects, and by which we are made aware of various diseased conditions, such as inflammation, injuries, etc.

3. **Sensations of temperature:** This is a sensation whereby the brain is able to determine whether an object is hot or cold, by means of impressions received by the brain from various nerves coming from special nerve endings in the skin.

4. **Muscular sense:** This is an important sensation whereby the brain is constantly informed of the position of the various joints of the body; such as the joints of the extremities. This enables us to walk about, without continually watching our steps, or to button our clothes without watching this act. In some diseases such as locomotor ataxia, where this sense is affected, the patient is unable to walk without watching his steps.

All the impressions received by the brain through the various senses are stored up in the cerebrum. When a similar impression is received again, it is at once recognized. For example—an object or color when seen again, is recognized as having been seen before, and under which circumstances it was seen.

MOTOR FUNCTIONS OF THE BRAIN

The impulses sent out from the brain are principally:

1. **Impulses for Motion**
2. **Impulses for Speech**

Impulses for Motion

Certain areas of the gray matter of the brain contain cells which constantly send out impulses to make the muscles contract, and thereby produce the various movements of the body. This part of the brain is called the **motor center.** There are two such centers; one on each side of the brain. Each side sends out impulses to cause motion of the opposite side of the body, and to regulate the movements of the extremities on that side of the body.

Impulses for Speech

There is an area of gray matter in the cerebrum, which sends out impulses to cause the complicated movements of the muscles of the larynx causing speech.

The speech center is situated only on one side of the brain, usually on the left, except in left-handed individuals, in whom it occurs on the right side.

MENTAL ACTIVITIES OF THE BRAIN

The following activities of the brain are called mental activities. They are not due to the action of any particular part of the brain, but to the action of a number of areas together, or by the action of one part of the brain upon another.

1. **Consciousness**
2. **Attention**
3. **Memory**
4. **Reasoning**
5. **Judgment**
6. **Emotion**
7. **Imagination**
8. **Will power**

Consciousness

By consciousness, we mean that we are aware of objects and persons about us, of the time of the day, of the place where we are, etc.

Consciousness depends upon our sensations; because the sensations inform the brain of our surroundings. When the sensations are increased, consciousness is increased; when they are diminished, consciousness is lessened. For example—morphine, a drug which lessens the appreciation of the sensations, produces unconsciousness, or sleep.

Attention

Attention is an activity whereby the brain keeps on receiving, sending out, and associating impulses only of one particular kind, at a certain time; that is, we are conscious only of a certain object. For example—when reading a certain book, we may have our attention so fixed on it, that

we may not see anyone coming into the room, nor objects about us. We may hear what anyone says, but yet not really know what was said.

Memory

Memory is an act of the brain whereby an impression that has been received, or an impulse that has been sent out some time ago, either by our sensations or by our actions or an experience, is recalled again. For instance, we may remember that on a certain day we saw a famous parade. The impression of the parade is so fixed in our mind that it can easily be recalled.

Reasoning

Reasoning is an act of the brain whereby old impressions that have been stored up in the brain, either by experience or study, or that were received through our sensations, are combined to form a definite conclusion. For example—it is by reasoning that we find out the cost of ten apples when we know the cost of four. We have learned that we must first find the cost of one apple. This fact has been stored in our brain by study. We have also learned that ten is ten times one. By combining these two impressions, we find the cost of one apple by division, and then multiply the result by ten.

Judgment

Judgment is a function whereby we are able to determine the relation between old impressions stored up in the brain by experience, by study or by the sensations, and the impressions just occurring in the brain through our senses. For example, on seeing a light burning, we may remark "the light is bright"; that is, we judge it by other similar impressions.

The foregoing mental activities of the brain are often called the **higher functions of the brain,** because when they are highly developed they are usually an indication of the degree of intelligence of an individual.

Emotion

Emotion is a subjective feeling which results from expectation, from knowledge and from impressions previously received by the brain. As a result of this feeling the brain

modifies the action of the body, the consciousness and the motor impulses sent out from the brain. For example, in watching an athletic contest, when our favorite team is successful, we shout, we laugh, we jump, we wave flags; in short, we are more active and more conscious. More impulses are sent out from the brain as a result of the feelings we experience from the tense expectation of victory and its effects as learned by previous experience.

The grief at the death of a friend or a relative, makes us less active, less conscious, less interested in objects about us, because of the impressions stored up in the brain as a result of the companionship of the deceased, and the contemplation of conditions due to his absence.

Emotions are of three kinds:

1. Emotions causing pleasant sensations. These emotions make the individual more satisfied; he is more active, more talkative, his spirits are brightened, he is gay, jolly and laughs easily.

The first example of the successful victory given above, is such an emotion. The most common pleasant emotions are joy and satisfaction.

2. Emotions causing unpleasant sensations. These emotions make the body less active. They often cause tremors of the muscles, crying, violent movements of the muscles or extremities; the individual moves constantly about, has a loss of appetite, etc. The second example of the grief at the death of a friend is such an emotion.

The most common emotions of this kind, are **grief, anger, fear, remorse.**

3. **Complex emotions.** These consist of subjective feelings that cause a mixture of the first and second groups of symptoms. Complex emotions are often called the tender emotions. The most common emotions of this kind are **sorrow, pity, gratitude, reverence, benevolence, love, sympathy.**

Imagination

Imagination is an act whereby the brain is conscious of objects that cannot be appreciated by the senses. The objects we imagine are really new combinations of old impres-

sions that have been stored up in the brain by the sensations, such as sight, hearing, touch, etc.; by study, by reading or by experience.

Every new work of the imagination such as a novel, a play, an opera, etc., is really a new combination of events, impressions, and experiences, encountered by the author in his lifetime, or gained by reading or study. There is therefore, really "nothing new under the sun."

Will Power or Inhibition

Will power or inhibition is an act of the brain whereby all its activities, which have just been described, as well as all the activities of the spinal cord, are regulated, controlled or kept in check. This is one of the highest functions of the brain.

For example, we may have an experience which may increase one of our emotions such as grief. Yet we may not manifest this grief because our emotion may be controlled or inhibited by our will power.

One of the emotions such as anger, may be stimulated to such an extent, as to cause the brain to send out impulses to strike the individual who may be the cause of our anger. We do not strike him, however, because our emotions are kept in check by the inhibitory action of the brain, or will power.

All the sensory, motor or mental activities of the brain when once performed, leave a record in the brain which may be revived at some future time.

ACTION OF THE CEREBELLUM

The cerebellum controls our equlibrium, that is, it regulates our movements in a straight line. It enables us to move forward, backwards, from side to side and up and down without staggering.

When the action of the cerebellum is disturbed, the patient usually staggers. If one side is affected, the patient usually staggers to one side.

ACTION OF THE MEDULLA OBLONGATA

The medulla oblongata joins the brain to the spinal cord. It consists of small areas of gray matter within, and white matter without. The areas of gray matter are called **centers.** Each center controls a certain action of the body, and constantly sends out impulses along certain nerves to cause or regulate these activities of the body.

Most of these activities are vital, because without them life cannot go on. The following are the most important centers in the medulla:

1. **The respiratory center,** which controls breathing.
2. **The cardio-accelerator center,** which makes the heart beat faster.
3. **The vagus or cardio-inhibitory center,** which makes the heart beat slower.
4. **The vaso-motor center,** which controls the width of the blood vessels.
5. **The vomiting center,** which sends out impulses to cause vomiting.

ACTION OF THE SPINAL CORD

The spinal cord is a long cord-like structure situated in the spinal canal, running from the skull to the sacrum. It has numerous nerves attached to it, which carry impulses to and from the cord.

The spinal cord consists of gray matter within, which contains all the cells, and white matter without, consisting of the fibers from these cells.

The function of the spinal cord is to cause an organ of the body to act, as a result of an impulse received from that organ, or from another part of the body by the spinal cord. Such an action, which depends upon an impulse received, is called a **reflex action.** (It is a reflected action, because it reflects the impulse received, by another impulse which is sent out.)

For example, when the bladder is full of urine, impulses are sent from its inner wall to the spinal cord, which at once sends impulses back to cause the muscles in the bladder to contract, thus expelling the urine from the bladder.

When a hot object is applied to the skin of the arm, an impulse is at once sent to the spinal cord, which immediately sends out another impulse to make the muscles of the arm contract, and the arm is drawn away.

Reflex actions are controlled by the inhibitory or checking action of the brain.

For example, when the bladder is full, it is ordinarily prevented from emptying itself for a time. This is due to the inhibitory action of the brain which holds the reflex action in check.

THE SYMPATHETIC SYSTEM

This consists of a chain of small nodules which extend on either side of the spinal column and are called ganglia. Each nodule contains a group of small nerve cells which act as relays for many of the nerve impulses passing from the medulla and spinal cord. These impulses are first transmitted along nerve fibres to the sympathetic ganglia and thence by other nerves to the organs or tissues to which they carry impulses. The following are the nerve impulses which pass through the sympathetic system:

1. The nerves which dilate the pupil of the eye.
2. The nerves which regulate the caliber of the small blood vessels (Vaso-motor nerves).
3. The Accelerator nerves, which increase the heart action.
4. The nerves going to the lungs.
5. The nerves going to all the organs in the abdomen and pelvis. These probably transmit impulses to lessen their contractions.

THE NERVES

The nerves are bands of white fibers, which go to, and come from the brain and spinal cord.

The nerves that carry impulses to the brain and spinal cord, are called **sensory or afferent nerves.** Those that carry impulses from the brain and spinal cord are called **efferent nerves.** The efferent nerves carry impulses to make the muscles contract, and to increase the secretion of the secretory glands.

The nerves terminate in the skin, the muscles, or the various organs of the body, by means of small microscopic bodies called **nerve endings.**

CONSCIOUS, SUBCONSCIOUS AND REFLEX ACTION

The activities of the nervous system are of three kinds:

1. **Conscious**
2. **Subconscious**
3. **Reflex**

Conscious actions are activities of the brain, of which we are aware; they occur only in the brain.

Subconscious actions are activities taking place in the brain while we are conscious of something else. We usually, however, later become conscious of subconscious activities.

For example, while we are conversing about a certain topic, we wish to recall the name of a particular individual. We are unable to do so, however, after considerable attempts, and we then give up the attempt. Some time later, while we are occupied with another topic, the name suddenly occurs to us, and we then remember the name we had been trying to recall.

A process has been going on in the brain, without our being aware of it, which has brought back the memory of the name.

Reflex action is an activity which is the result of a stimulus

received by the sensory nerves from the skin or other parts of the body.

Reflex actions may occur in the brain and spinal cord. In the spinal cord all the activities are reflex.

MODE OF ACTION OF THE NERVOUS SYSTEM

The action of the nervous system can be easily understood, if we compare it to a telephone system.

A telephone system consists of a central station, which receives messages from wires leading to, and coming from this central station. Messages are sent to the central station, by means of the transmitter, and they are received through the receiver.

The central station keeps all the subscribers in touch with one another. Some subscribers do not communicate directly with the central station, but by means of a sub-station, or a private switchboard. This sub-station must first be communicated with before reaching the central station or any of the subscribers connected to it.

The nervous system acts in a similar manner (see diagram, page 284).

The brain is the central station, which keeps the various organs of the body in communication with one another.

Some organs, such as the eye, the ear and the nose, communicate directly with the brain, through their nerves. In fact all the cranial nerves communicate directly with the brain. These nerves correspond to the wires leading directly to or from the central station of the telephone system.

The sensory nerve endings correspond to the **transmitters** which send impulses along the sensory nerves to the central station, **the brain.**

The motor or **secretory nerve endings** correspond to the **receivers** which receive impulses from the brain, the central station.

The spinal cord corresponds to the **sub-station** or **switchboard.**

Some parts of the body do not communicate directly with the brain, the central station, but through the spinal cord, which corresponds to the sub-station or switchboard. All the impulses from the skin of the trunk and extremities reach the brain in this way. All the impulses for motion reach the muscles of the extremities and trunk indirectly, through the spinal cord.

Just as an institution, having a private switchboard, can

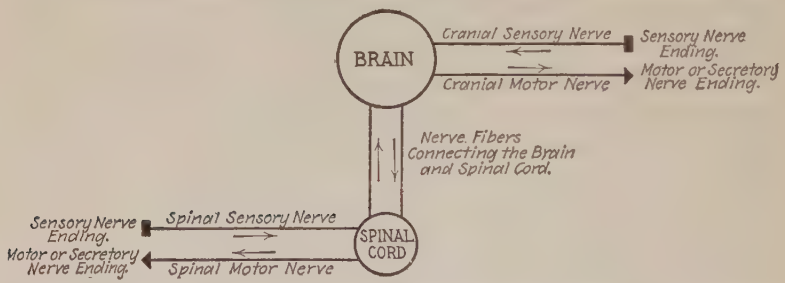


Diagram illustrating the action of the nervous system. The arrows indicate the direction in which the impulses travel

connect any of its individuals in one part of the building with other individuals in a different part of the building; so an impulse going to the spinal cord, may cause another impulse to be sent out from the spinal cord, without such an impulse being sent to, or coming from the brain. Such an action is a reflex action.

Mode of Action

For example: When an automobile is seen coming along the street at great speed, we at once get out of its way. The impulse received by the eye when the automobile is seen, is sent to the brain.

The brain then sends out impulses to the spinal cord, which in turn sends impulses to the muscles of the lower extremities causing them to contract. The legs are then moved and we get out of the way of the automobile.

The eyes are thus kept in communication with the muscles of the lower extremities.

Considering the nervous system as a telephone system, the message (the sight of the automobile) is sent to the

central station, the brain. This at once sends a message to the sub-station, the spinal cord, which in turn sends a message to the lower limbs, causing them to move.

EFFECTS OF DRUGS ON THE NERVOUS SYSTEM

Drugs affect the nervous system in two ways:

1. Increasing its activity, **stimulation.**
2. Lessening its activity, **depression.**

CEREBRAL STIMULATION

Drugs may increase the activity of the entire brain, or only of certain areas of it. In the latter case, only some of the activities of the brain are increased, while others may be normal or even diminished.

Stimulation of the Sensory Activities of the Brain

When the action of the areas of the brain which receive sensory impulses, is increased, the brain receives more impulses through the various senses. The patient is therefore brighter, wider awake, and appreciates his surroundings better; that is, he is more conscious, because consciousness is the result of the sensations received through the various senses.

The patient appreciates all the various sensations better; such as the sense of pain, touch, heat, cold, etc.

Illusions and Hallucinations

When the various sensory areas of the brain are made very active, certain impressions which had been received through the various senses and stored up are revived. The patient then has sensations which do not exist. For example—stimulation of the area for receiving impulses of sight, makes the patient see objects that do not exist. Such impressions are called **hallucinations** or **illusions.** In this example they are **illusions** or **hallucinations of sight.**

If the area for the reception of sound is thus overstimulated, the patient may hear sounds, noises or voices, that do not exist. These are called **hallucinations of sound.**

If the area for the appreciation of the sense of touch is

over-stimulated, the patient may feel things that do not exist, such as objects or animals creeping over the skin. These are called **hallucinations of touch.** This often occurs in alcoholic delirium, or delirium tremens.

If the area of the brain which receives sensations of taste or smell is thus affected, the patient may taste or smell objects that do not exist. These are called **hallucinations** or **illusions of taste or smell.**

Stimulation of the Motor Areas of the Brain

When the areas of the brain which send out impulses for motion, are stimulated, the patient moves about more, and is more active, because of the greater number of impulses for motion which are sent out from the brain.

Convulsions

When the motor areas of the brain are over-stimulated, however, the impulses for motion are so active, and so many, that instead of regular coördinated movements of the muscles, violent contractions, or convulsions result.

Convulsions are of two kinds: **Clonic** and **Tonic.**

Clonic convulsions are repeated single contractions of the muscles of the body.

Tonic convulsions are prolonged contractions of the muscles of the body. During a tonic convulsion the muscles are very rigid.

Stimulation of the Speech Center of the Brain

When the activity of the speech center of the brain is increased, the patient becomes more talkative.

Delirium

When the activity of the speech center of the brain is very greatly increased, for example: by drugs, or by the poisons of infectious diseases, all the impressions and memories for speech that have been stored up in the brain are sent out.

The patient talks continuously; of numerous objects that he has seen in the past, or that he seems to see at present. He may speak various words of different languages that he has heard at some time in his life, etc. This condition is called **delirium.**

The same causes which increase the activity of the speech center, also increase the activity of the motor areas of the brain. Delirium is often accompanied then, by excessive movements of the muscles and often by convulsions.

Stimulation of the Mental Functions of the Brain

Drugs which increase the activity of the brain also increase the mental activities of the brain. When these activities are increased, the patient is able to concentrate his mind better and pay closer attention. The reasoning and judgment are also increased and the memory is better.

When the imagination is increased, the patient is better able to combine old impressions into new ones. They may have visions of various objects, places and people. They may imagine new kinds of sounds, etc.

Often the imagination is increased, while the activity of the sensory areas of the brain is lessened. The patient is then unconscious (asleep) but the increased activity of the imagination results in various dreams. Such effects are produced by morphine.

When the inhibitory action of the brain is increased, the patient is able to control the various activities of the brain and other organs better.

STIMULATION OF THE MEDULLA OBLONGATA

When the activity of the medulla of the brain is increased, the various centers which it contains become more active. If the **respiratory center** is stimulated, the breathing is deeper and faster.

If the **cardio-accelerator center** is made more active, the heart beats faster and stronger.

If the **vagus** or **cardio-inhibitory center** is increased in activity, the heart beats slower.

If the **vaso-motor center** is more active, the blood vessels become narrower, and the pulse is tense, and the blood pressure is greater.

If the **vomiting center** is made more active, the patient usually vomits frequently and profusely.

The entire medulla is rarely stimulated. Most drugs affect only certain centers in the medulla.

STIMULATION OF THE SPINAL CORD

When the spinal cord is made more active the patient is able to respond to all stimuli and impressions received by the senses, more rapidly and with greater force.

For example: When the spinal cord is stimulated, the application of a hot object to the hand will cause the arm to be forcibly drawn away, and may even cause convulsions, if the spinal cord is greatly stimulated.

Drugs which increase the activity of the spinal cord, such as strychnine, act as a tonic. This is due to the improvement in the activities of various organs of the body because of the increased reflex action. Such actions as breathing and movements of the bowels, which are reflex actions, or which are increased by reflex action, are improved.

STIMULATION OF THE NERVES AND NERVE ENDINGS

If the sensory nerves or nerve endings are made more active, the patient becomes more sensitive to pain, to heat and to cold. There may even be tingling in the areas of skin affected, a feeling as if there was some object creeping on the skin (formication).

If the efferent or motor nerves are thus affected, the patient may have twitchings of the muscles, if they are motor nerves or nerve endings. If the secretory nerves or nerve endings are thus affected, the glands supplied by these nerves secrete more profusely.

EFFECTS OF EXCESSIVE STIMULATION

When drugs increase the activity of the brain too much (over-stimulation), which often results from excessive doses of cerebral stimulants, the effects are those of lessened activity or **depression.**

The patient becomes less conscious, **falls asleep,** or becomes still more unconscious, and finally goes into a **stupor** (a deep sleep from which he can be awakened with difficulty). Later, **coma** develops (a deep sleep from which the patient cannot be aroused at all).

CEREBRAL DEPRESSION

Drugs may lessen the activity of the entire brain or only of certain areas of it. In the latter case, only some of the activities of the brain are lessened, while others may be normal or even increased.

Depression of Sensation

When the activity of the sensory areas of the brain are lessened, fewer sensory impulses reach the brain.

The sense of pain, touch, heat, cold, sight and hearing and all other sensations are lessened. Many drugs, for example, morphine, relieve pain in this way.

Since consciousness depends upon the sensory impulses received by the brain, when the reception of these impulses is lessened, the patient is less conscious, or may even be unconscious or asleep.

In overactivity of a cerebral depressant, stupor and coma result.

Motor Depression

When the action of the motor areas of the brain is lessened, fewer impulses for motion are sent out from the brain. The patient is then less active, he usually walks about more slowly and when the effect is marked he may even remain in one place without any desire to change his position.

Depression of the Speech Center

When the activity of the speech center is lessened, the patient is less talkative; and when he does speak, he is apt to speak slowly and in a low voice.

Depression of the Mental Functions of the Brain

Drugs which lessen the mental activities of the brain make the patient dull and stupid. He is unable to fix his attention or concentrate his mind on any subject, for any length of time. The reasoning is very slow and poor, the memory

is very poor and the patient is very forgetful. He is usually dull and unemotional.

When the inhibitory action or will power is lessened, the patient is unable to control the various activities of his brain and other parts of the body.

For example, the action of alcohol begins by lessening the will power. It therefore removes the inhibition from the speech center. It makes the patient talkative, and the individual often says things that may be foolish or improper.

DEPRESSION OF THE MEDULLA

Drugs which lessen the activity of the medulla usually lessen the action of its various centers.

When the action of the **respiratory center** is lessened, the breathing is slower and shallower.

Lessening the activity of the **cardio-accelerator center** lessens the impulses which make the heart beat faster, so that the heart then beats slower and weaker.

When the action of the **vagus** or **cardio-inhibitory center** is lessened, fewer impulses for slowing the heart reach it. The heart therefore beats faster.

When the activity of the **vaso-motor center** is lessened, the blood vessels become widened and the skin becomes flushed. The pulse is therefore softer and more bounding in quality.

DEPRESSION OF THE SPINAL CORD

When the activity of the spinal cord is lessened, the patient usually responds to stimuli less readily. In other words, the reflex action is lessened. It therefore lessens the activity of various organs of the body such as the movements of the bowels, breathing, etc., which are helped by reflex action or which act in a reflex manner.

DEPRESSION OF THE NERVES AND NERVE ENDINGS

When the activity of the **sensory nerves** or their nerve endings is lessened, the patient does not appreciate sensations

such as touch, temperature, pain, etc. It often produces numbness in the areas supplied by these nerves.

When the activity of the **efferent nerves** is lessened the following results are produced:

Lessened contractions of the muscles if they are **motor nerves.** If the depression is very great, as in overactivity of the drug, paralysis results.

Lessening the activity of the **secretory nerves** or their nerve endings, results in diminished secretion of these glands.

CHAPTER XVI

BRAIN AND SPINAL CORD STIMULANTS

CAFFEINE (CAFFEINA)

Caffeine is a white crystalline powder, the active alkaloid of the coffee bean, **Coffea arabica.** It is also found in tea leaves, **thea chinensis** of China; in **Paraguay tea** of Argentine and in the **kola nut** of Central Africa and the **guarana paste** of Brazil.

Coffee was originally used by the Arabians, but it is now a universal beverage. It causes the same effects as caffeine, for the action of coffee is due principally to the caffeine which it contains.

Coffee and tea are very commonly used beverages. They are infusions of the coffee bean or of tea leaves. The coffee bean contains about $\frac{2}{3}\%$ of caffeine. A cup of coffee contains about 0.1–0.2 gm. (grs. i–iii) of caffeine. Coffee has a laxative effect because of volatile oils which it contains.

Tea contains about $1\frac{1}{2}$ to 2% of caffeine. A cup of tea also contains 0.1–0.2 gm. (grs. i–iii) of caffeine. Tea contains a large amount of tannic acid, which contracts mucous membranes (astringent action).

Appearance of the Patient

When a patient is given an average dose of caffeine, or when a strong cup of coffee is taken, the following effects are noticed:

The patient is more wakeful, brighter, and is able to think more quickly and better, and to reason better. In fact, all mental work can be done better and with less fatigue. The patient is more active and responds more easily, more rapidly and better, to all influences about him. The pulse is quicker and may be stronger, and the breathing is deeper and more frequent. The patient also urinates more frequently and passes more urine.

Caffeine is an ideal stimulant, because it increases the activity of almost every organ of the body. Its effects appear in about a half to one hour after it is given, and last only for one or two hours.

ACTION

Caffeine produces no effects when applied locally on either the skin or mucous membranes.

Internal Action

In the mouth: Caffeine has a slightly bitter taste.

In the stomach and intestines: Caffeine produces no effects. Coffee, however, because of a number of volatile oils which it contains, increases the peristalsis, causing mild movements of the bowels.

Action after Absorption

Caffeine is absorbed into the blood in about a half to one hour. It then affects principally the brain, the circulation, the respiration, the muscles and the kidneys. The effects last for a very short time.

Action on the Brain: Caffeine increases the action of every part of the brain. Impulses reach the brain faster. More impulses are sent out from the brain, and these are sent out more rapidly. As a result of this action, the patient is more wakeful and brighter; he sees and hears better. He appreciates influences about him more easily and is able to respond to them more readily. He is able to think better, easier and faster. He reasons better, his ideas arise more readily, he can express them with greater ease, and he can remember better. He is more active, more talkative, and absolutely rational in everything he says or does.

These effects result from increased action of the various regions of gray matter in the brain. For instance, the greater activity of the patient, is due to more impulses being sent out from that part of the gray matter of the brain which controls motion. The patient is brighter and wakeful because he is more susceptible to influences and impressions received from his environments. He appreciates the im-

pressions received through his various senses much better; and this keeps him wakeful. He reasons better, because the impressions which are received in the brain are rapidly combined into new ones. The memory is better, because impulses are more rapidly sent out from the various areas of gray matter of the brain where old impressions had been stored up.

Action on the Spinal Cord: The action of the spinal cord is increased by caffeine. As a result, the patient responds more quickly and more actively to impressions received through his various senses (reflex action). For instance, the muscles contract better because their tone (a state of mild maintained contraction) is increased, the bowels move better because they respond faster when they become distended; The reflex response to impulses such as pain, is increased.

Action on the Circulation: In the doses that are usually given, caffeine has no direct effect on the heart.

Action on the Blood Vessels: The small blood vessels, however, are made narrower by contraction of the muscle fibers in their walls as a result of the impulses sent to them from the area of gray matter in the medulla which controls the caliber of these vessels (vaso constrictor center). As a result of this action the pulse becomes somewhat more rapid, and perhaps stronger, for a very short time, and there is a slight evanescent rise in blood pressure.

Action on the Kidneys: Caffeine increases the flow of urine by directly affecting the cells of the kidneys. It is one of the best diuretics. It dilates the blood vessels of the kidney, thus also improving the circulation of the kidney.

Excretion

Caffeine is excreted mainly by the kidneys in a few hours. Very little caffeine is excreted as such. Most of it is changed to urea, a normal constituent of urine.

Poisonous Effects

Acute caffeine poisoning is very rare, because the caffeine

is excreted very rapidly. The following symptoms were present in a few cases that have occurred:

1. Headache.
2. Confusion.
3. Noises in the ear.
4. Flashes of light.
5. Delirium.
6. Palpitation of the heart.
7. Rapid weak pulse.
8. Short quick breathing.
9. Convulsive movements of the hands and tremors of various parts of the body.
10. Profuse flow of urine.
11. Collapse (pallor, cold moist skin, rapid thready pulse, slow and shallow breathing, cold extremities).

Chronic Caffeine Poisoning—"Coffee Habit"

This occurs particularly in people who drink strong coffee habitually. The patient is very nervous, is easily excited and disturbed even by the slightest noise. He is unable to sleep, complains of headache, palpitation of the heart and twitching of the fingers and hands. The pulse may be rapid and irregular.

When the patient stops drinking coffee, all these symptoms disappear.

Administration

Caffeine is given in capsules, tablets or powders. It should be given well diluted in water. Since its effects appear rapidly and soon pass off, it is better to give small doses, frequently repeated, than a single large dose. When the effect of one dose wears off, there is more caffeine in the body to produce its effects.

Uses

Caffeine is one of the best stimulants for collapse. The effect is due to the stimulation of the brain, the breathing and to the contraction of the blood vessels. It is also an excellent diuretic. In heart weakness, in the course of in-

fectious diseases, caffeine is a valuable drug, because of the general stimulation of the patient and the contraction of the usually dilated blood vessels.

Preparations

Caffeine (Caffeina)	0.06–0.3 gm.	grs. i–v
Caffeine Citrate (Caffeina Citrata)	0.06–0.5 gm.	grs. i–viii
Effervescent Caffeine Citrate (Caffeina Citrata Effervescens)	4.0 gms.	ʒi

This is a mixture of caffeine citrate, sodium bicarbonate, tartaric acid and sugar, containing 4% of caffeine citrate. It effervesces when dissolved in water.

Caffeine Sodium Benzoate (Caffeina Sodii Benzoas) (Unofficial)	0.06–0.3 gm.	grs. i–v

This is an excellent preparation for hypodermic use. It is usually kept in 25% stock solutions.

Guarana

Guarana is a paste made from the seeds of **Paullinia sorbilis**, a Brazilian plant. It contains **caffeine and tannic acid.** It is used for sick headache and neuralgia. In Brazil, it is also used to check diarrhoea because of the tannic acid which it contains.

Preparations

Fluidextract of Guarana (Fluidextractum Guaranae)	2.0 c.c.	m. xxx

There are numerous preparations of the kola nut on the market. Many of them are used as stimulating drinks, because of the caffeine which they contain.

NUX VOMICA AND STRYCHNINE

Nux vomica is obtained from the seeds of the **Strychnos nux vomica**, and **Strychnos ignatia**, trees which grow in the East Indies. The seeds are round, flat discs about the size

of a five cent piece, and are often called **poison nut,** or **quaker buttons,** because they resemble gray buttons.

The active principles are two alkaloids: **strychnine** and **brucine.** The effects of both are the same; brucine being half as strong as strychnine. Nux vomica also contains an acid, **igasuric acid.**

The action of nux vomica is due to the strychnine which it contains, so that the effects of the drug are the same as those of its active principle.

Appearance of the Patient

When strychnine or a preparation of nux vomica is given, the patient complains of its very bitter taste. The appetite is increased and digestion is improved. The patient feels stronger and more energetic. The pulse is slower and stronger, and the breathing is deeper and more rapid.

All the sensations are better appreciated. The sight and hearing are more acute. The sense of touch is more sensitive. The body responds more quickly and more vigorously to all impressions received through the various senses. These effects are usually noticed only after prolonged use.

ACTION

Local action: No effects are produced when either nux vomica or strychnine are applied to the skin or mucous membranes.

Internal Action

In the mouth: Strychnine has a very bitter taste. It is one of the bitterest substances known; a 1–1,000,000 solution gives a bitter taste. Because of the bitter taste, it increases the appetite and the flow of saliva.

In the stomach: Strychnine increases the secretion of gastric juice, and the peristalsis of the muscle wall of the stomach. The digestion is thus aided, and the food is quickly passed on to the intestines.

In the intestines: It increases the secretion of the mucous membranes and the peristalsis. Frequent movements of the bowels then result.

The increased peristalsis of the stomach and intestines produced by strychnine, is due to its effect on the mucous membrane of these organs, and to its action on the spinal cord. The effect on the mucous membranes sends impulses to the spinal cord, which is especially made more active. The spinal cord then sends out more and faster impulses to contract the muscles of the stomach and intestines.

Action after Absorption

Strychnine is absorbed into the blood mainly from the intestines, in about one or two hours. After absorption, it affects principally the circulation, the respiration, and the spinal cord.

Action on the circulation: On the heart: Strychnine makes the heart beat slower, by causing the vagus or inhibitory center in the medulla to send more impulses for slowing the heart.

On the blood vessels: It makes the blood vessels narrower; especially the small blood vessels in the abdomen. This is due to the effect on the vaso-motor center in the medulla, an area of gray matter which sends out impulses to control the width of the blood vessels. Strychnine makes this center more active. More impulses are then sent to the muscle fibers in the walls of the blood vessels to make them contract. The blood vessels then become narrower, and offer a greater resistance to the contractions of the heart, which then beats stronger. The blood pressure is also increased by the contraction of the blood vessels.

The total effect of strychnine on the circulation is therefore to **make the heart beat slower and stronger.** The characteristic **strychnine pulse is slow and strong.**

Action on the respiration: The breathing is deeper and faster because of the increased impulses for breathing sent out by the respiratory center in the medulla.

Action on the nervous system: Strychnine increases the appreciation of all the various sensations; thus pain is felt more keenly, the senses of smell and taste become more acute. The patient is able to see and to hear somewhat

better, and to appreciate various objects better through the sense of touch.

Action on the spinal cord: This is the most important action of strychnine. Most of the strychnine effects result from its action on the spinal cord and medulla. It enables the terminations in the spinal cord of the sensory nerves, to transmit their impulses more readily to the cells in the gray matter of the spinal cord. These cells then respond more readily to any impulse which reaches them along the sensory nerves, thus increasing the reflex action.

As a result of the increased reflex action all the activities of the body which are affected by impulses received through the various sensory nerves, are increased.

In this way, strychnine acts as a tonic, improving the activity of every part of the body. The patient responds better and more readily to all the impressions received through the various senses. His muscles contract better, because they respond more easily and more readily, to impressions received through the various senses. After continued strychnine administration the individual is therefore able to do more work.

The appetite and digestion are better, and the bowels move more often, because of the increased reflex action which makes the gastric and intestinal muscles respond more easily to any substance affecting their mucous membranes.

The heart beats stronger, and the breathing is more rapid and deeper.

As a result of all these effects on the various organs of the body, the patient feels stronger, healthier, and his general condition is improved.

Excretion

Strychnine is excreted mainly by the kidneys, though very slowly. It takes about three to seven days for the drug to be entirely eliminated.

Poisonous Effects

Strychnine poisoning occurs in two forms: acute poisoning and cumulative poisoning.

Acute Strychnine Poisoning

Acute strychnine poisoning usually results from an overdose of strychnine, or when a preparation of the drug is taken with suicidal intent. The symptoms appear very soon after it is taken, usually in about fifteen minutes.

Symptoms

1. The patient complains first of **stiffness of the muscles** of the neck or face, and of slight stiffness of the jaw; soon there follows **twitching of the face or arms.**

2. **Sudden tetanic convulsions of the whole body then occur.** The arms and legs are rigid and extended. The head is drawn back, and the back is bent so that it forms a concavity (opisthotonus). The contractions of the facial muscles draw up the corners of the mouth, causing a peculiar grin and ghastly expression known as the "risus sardonicus."

The convulsions are due to the increased reflex action, and are brought on by the slightest stimulus; such as a gust of air, the touch of a blanket, a flash of light or the slam of a door. After the convulsion, all the muscles are relaxed and there is a feeling of soreness, but the slightest touch, a gust of wind, or a loud noise, at once produces another paroxysm.

3. The contractions of the muscles of the diaphragm, during the convulsions, give the **face and lips a blue color,** from the lack of oxygen in the blood, due to the interference with the breathing.

4. **The pulse is slow and stronger,** but during the convulsions it is often rapid and weak.

5. The convulsions become more frequent and often clonic in character, and the patient finally dies of asphyxia, in about two or three hours, the mind remaining clear to the end.

The symptoms of strychnine poisoning are all due to its effect on the spinal cord. In a normal individual, an external stimulus, such as touching the skin, etc., sends an impulse to the spinal cord which results in the contraction of only one, or of a number of muscles; so as to draw the arm or leg away from the stimulus. In strychnine poisoning afferent impulses are received so readily by the spinal cord,

that even the slightest stimulus causes a marked response. So many impulses are suddenly sent out from the cord, that violent contractions of all the muscles of the body, or convulsions result.

Treatment

1. Give tannic acid or tea to combine with the strychnine.
2. Wash out the stomach or give emetics (but not during the convulsions) if strychnine has been taken by the mouth.
3. If the patient has convulsions, give ether to control them, and then wash out the stomach.
4. To prevent the convulsions from returning, chloral or bromides are given repeatedly.
5. Catheterize; to prevent reabsorption of the strychnine from the urine.
6. Give artificial respiration and oxygen when the patient is blue and cyanotic.

Cumulative Strychnine Poisoning

Since strychnine is rapidly absorbed and very slowly excreted, some of it always remains in the body when it is given continuously, and often causes cumulative symptoms. These symptoms, which result from the accumulation of strychnine in the body, are the same as the acute symptoms, but they develop more slowly.

Symptoms

1. The earliest symptoms which indicate that the patient is getting too much strychnine, are **twitching of the muscles of the face** or of the **extremities,** such as shrugging of the shoulder or twitching of the fingers.
2. Often the earliest symptom may be **diarrhoea.**
3. Soon the patient complains of stiffness of the neck and jaw or in the muscles of the face.

If the drug is continued, convulsions may occur.

Treatment

Stop the drug as soon as the earliest symptoms are

noticed. This enables the strychnine in the body to be eliminated, and further symptoms are avoided. If other symptoms occur, the treatment is the same as for acute poisoning.

Uses

Strychnine is used principally for the following effects:

1. As a heart and respiratory stimulant in collapse.
2. In various forms of paralysis, to increase the contractions of the muscles.
3. As a tonic, to improve the general health and strength of the body.
4. To increase the appetite and to improve the action of the bowels.

Administration

For rapid effect in collapse, strychnine should be given hypodermically.

To increase the appetite, nux vomica is usually given, before meals undiluted.

Preparations

Nux Vomica

Solid Preparation:

Extract of Nux Vomica (Extractum Nucis Vomicae)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i

Fluid Preparations:

Fluidextract of Nux Vomica (Fluidextractum Nucis Vomicae)	0.06 –0.3 c.c.	m. i–v
Tincture of Nux Vomica (Tinctura Nucis Vomicae)	0.3 –1.0 c.c.	m. v–xv

This is the preparation most frequently used as a tonic.

Strychnine

Strychnine (Strychnina)	0.0015–0.004 gm.	gr. $\frac{1}{40}$–$\frac{1}{15}$
Strychnine Sulphate (Strychninae Sulphas)	0.0015–0.004 gm.	gr. $\frac{1}{40}$–$\frac{1}{15}$

This is the preparation used hypodermically in collapse. In hospital practice it comes in a 1% solution or weaker.

Strychnine Nitrate (Strychninae Nitras) 0.0015–0.004 gm. gr. $\frac{1}{40}$–$\frac{1}{15}$

Non Official Preparations

Iron and Strychnine Citrate (Ferri et Strychninae Citras) 0.06 –0.2 gm. gr. i–iii

Syrup of Iron, Quinine and Strychnine Phosphate (Syrupus Ferri, Quininae et Strychninae Phosphatum) 4.0 –8.0 c.c. ʒi–ii

This contains $\frac{1}{80}$ of a grain of strychnine in each ʒi dose.

Elixir of Iron, Quinine and Strychnine Phosphate (Elixir Ferri, Quininae et Strychninae Phosphatum) 4.0–8.0 c c. ʒi–ii

It contains $\frac{1}{64}$ of a grain of strychnine in each ʒi dose.

PART V. B.—DRUGS WHICH DEPRESS THE CENTRAL NERVOUS SYSTEM

CHAPTER XVII

BRAIN AND SPINAL CORD DEPRESSANTS

We may classify the drugs which lessen the action (depress) of the brain in the following groups. (See page 289 for cerebral depression).

1. **Analgesics**
2. **General Cerebral Depressants**
3. **Progressive Cerebral Depressants**
4. **General Anaesthetics**
5. **Hypnotics**

Analgesics are drugs that are used principally to relieve pain. Many of the analgesics depress certain functions of the brain while stimulating others.

General Depressants are drugs that lessen the action of the entire brain.

Progressive Depressants are drugs that progressively depress the functions of the brain. They usually depress the higher functions such as inhibition first, thus removing the restraint from the brain activities and causing a stage of excitement. This is followed by progressive depression of all the other functions. In poisonous doses they may produce unconsciousness. Since the excitement is the most apparent symptom, the progressive depressants are often called **intoxicants.**

General Anaesthetics are drugs that produce unconsciousness and insensibility to pain. They usually progressively depress the brain like the Progressive Depressants. The excitement stage, however, is of very short duration and is soon followed by the stage of unconsciousness which may last for a long time and is not accompanied by other poisonous effects.

Hypnotics are drugs that lessen the function of the brain so as to produce sleep, without causing insensibility to pain.

In this chapter we shall consider only the analgesics, general depressants and progressive depressants.

ANALGESICS

Analgesics are drugs which are used principally to relieve pain. Pain can be relieved in several ways:

1. By lessening the activity of the sensory areas of the brain so that the impulses of pain which the brain receives, are not appreciated.

2. By lessening the activity of the nerve endings in the skin which receive the impulses of pain.

Drugs which relieve pain are divided into two classes:

1. **Analgesics**
2. **Anodynes**

Analgesics are drugs which relieve pain when given internally.

Anodynes are drugs which relieve pain when applied to the particular site where the pain is felt.

The most important analgesic is opium and its principal alkaloid, morphine. The anodynes will be considered under their appropriate local effects. (See Local Anaesthetics, page 433.)

OPIUM AND MORPHINE

Opium is the hardened dried juice of the unripe capsules of the **Papaver somniferum** or white poppy, a plant which grows principally in Turkey, Asia Minor, Persia, India and China. The drug is obtained by making a longitudinal or transverse cut in the capsule, when a thick white milky juice oozes out. This is exposed to the air, and allowed to dry, when it turns brown and hard. This dried juice is the crude opium, from which all the preparations are made. It has a peculiar characteristic odor.

Opium is one of the oldest drugs in medicine. It is the

most reliable and most useful drug in the entire Materia Medica. It relieves pain better than anything else, no matter what the cause of the pain may be.

Active Principles

The active principles of opium are the following alkaloids:

Morphine
Papaverine
Codeine
Narcotine
Thebaine

Opium also contains a number of other unimportant substances.

The action of opium is due principally to the **morphine** which it contains, amounting usually to 9% of the drug. Morphine affects principally the brain, while the other alkaloids in the order given above, do not affect the brain as much, and act more upon the medulla and spinal cord. Thebaine, the last member of the group, produces effects similar to those of strychnine, which are due principally to the action on the spinal cord.

Appearance of the Patient

About ten to fifteen minutes after giving an average dose of opium or morphine, the patient complains less of the pain from which he may have been suffering. He becomes calm, abstracted and quiet, and feels comfortable. When spoken to, he may not answer, because of his drowsy, abstracted condition. He may lie in a quiet dreamy state, in which he seems to see various objects and persons about him, and seems to be in various places. These dreams may be so pleasurable, that the patient forgets everything—pain, cares, worries. Time passes rapidly on and he lives in a world of his own.

Soon, however, the patient falls into a light sleep from which he can be easily aroused. During the sleep, he may have vivid dreams, many of which he often remembers afterwards. Often the sleep is deeper, resembling the natural sleep.

The breathing is slow and shallow, the pulse is perhaps somewhat slower, the face is flushed, the pupils are contracted and the skin may be moist. These effects last for several hours, and gradually wear off, leaving the patient feeling dull and depressed, with dryness of the throat and occasionally a slight headache and nausea.

ACTION

Local action: Applied to the skin, opium or morphine produces no effect.

Mucous membranes are contracted, and the secretions are checked by opium or morphine. It may be slightly absorbed from wounded surfaces and mucous membranes when locally applied to them, but whatever effects then result are due to absorption.

Internal Action

In the mouth: Opium or morphine has no effect.

In the stomach: It checks the secretion of gastric juice and lessens the peristalsis. It also lessens the appetite and the feeling of hunger. These effects result from absorption, however. Later, however, opium or morphine increases the secretions in the stomach and may even cause nausea and vomiting. This may be due to the formation of apomorphine in the body which then affects the vomiting center.

In the intestines: The secretions of the mucous membrane and the peristaltic contractions of its muscle wall are markedly lessened, causing constipation. The effect is due to absorption, however.

Action after Absorption

Morphine is very rapidly absorbed into the blood through the mucous membrane of the stomach, usually in about ten or fifteen minutes. It can also be absorbed from all the mucous membranes. When given hypodermically, it acts in about two to five minutes. Opium preparations are absorbed more slowly. After absorption, opium and morphine affect principally the brain, the respiration, the secretory glands and the pupil.

Action on the Nervous System

On the brain: Opium or morphine lessens all the activities of the brain except the imagination, which is frequently made more active.

On the sensory areas: It lessens the activities of all the sensory areas of the brain. Thus the appreciation of all sensory impulses, especially that of **pain, is lessened.** Since consciousness is the result of the sensory impressions received through our sensations, by lessening the appreciation of the sensations, opium or morphine **produces unconsciousness or sleep.** When the patient is unable to sleep on account of pain, these drugs are particularly valuable. The sleep is light, however, and the patient may be easily awakened. Often it is deeper and resembles the natural sleep.

On the motor areas: The action of the motor areas of the brain is slightly lessened, so that the patient is not quite so active.

On the mental activities: The higher mental activities of the brain, such as will power, judgment, reasoning, and concentration are all lessened.

The action of the imaginative center of the brain, however, is frequently increased. The patient is then able to combine old impressions that have been stored up in the brain, more readily and more rapidly into new ones. The resulting thoughts then flow more freely. The increased activity of the imagination is more marked in the more educated, and higher intellectual types of individuals or those having a vivid imagination. Some very excellent literary works have been written while the author was under the influence of opium, when his imagination was very active.

As a result of the greater play of the imagination, vivid dreams may occur during the sleep resulting from opium or morphine. Even when the patient is awake, but under the influence of the drug, he may be absorbed in various thoughts and visions which may be conjured up before his mind. These produce a feeling of pleasure and comfort, and preoccupy the mind so that he forgets everything—pain, worries, cares, even the idea of time. It is because of these

pleasant effects, that opium tends to form a habit, especially after prolonged administration. The opium habitué may even have brilliant ideas while under the effect of the drug, but because the will power is lessened, he is unable to carry these ideas into effect.

Action on the respiration: Opium or morphine makes the breathing slower and shallower by lessening the impulses for breathing, sent out from the respiratory center in the medulla.

Action on the circulation: It produces no effect on the heart.

The blood vessels of the face and neck are dilated, however, causing a flushed face and a feeling of warmth.

The pulse after opium or morphine is usually normal and strong. With larger doses, the pulse is somewhat slower.

This is due to the slow breathing which prevents the blood from getting the proper amount of oxygen, and the character of the pulse is due to the slight asphyxia which results.

Action on the secretory glands: Opium or morphine checks all the secretions except the sweat, which it increases.

The flow of saliva, of bile and of the secretions of the mucous membranes of the stomach and intestines are all lessened. The secretion of urine is often markedly diminished.

The perspiration is increased more by the preparations of opium than by those of morphine.

Action on the involuntary muscles: The contractions of the involuntary muscles are lessened. Intestinal peristalsis is thus lessened; which, in addition to the diminished secretion of the intestines, causes constipation.

Action on the pupil: Opium or morphine contracts the pupil. It makes the pupil very small when given internally. When applied locally to the conjunctiva it produces no effects.

Excretion

Opium or morphine is rapidly eliminated from the body, mainly by the digestive tract, into the stomach, intestines and saliva and slightly by the urine, usually in about an hour. The drug is frequently absorbed again from the stomach and intestines.

Summary of Effects

The most important effects of opium or morphine are the following:

1. It relieves pain.
2. It makes the breathing slower.
3. It lessens all the secretions, except the sweat; which is increased.
4. It checks peristalsis, producing constipation.
5. It contracts the pupil.

Idiosyncrasies

a. Idiosyncrasies of Effect.

In some individuals, the following unusual effects occasionally occur:

1. Weakness and depression.
2. Continual nausea and vomiting.
3. Delirium and excitement. (This is especially apt to occur in women.)
4. Convulsions.
5. Redness of the skin and itching when the effects are passing off.
6. Diminished secretion of urine, especially in cases of nephritis.

b. Idiosyncrasies of Dose.

In some individuals **a very small dose may cause very deep sleep,** and even poisonous effects. In others, a very large dose may cause no effects at all, or only slight effects. Old people and children are very susceptible to opium or morphine. They may get poisonous symptoms from very small quantities.

Poisonous Effects

Poisoning from opium or morphine occurs in two forms: acute opium poisoning and chronic opium poisoning or opium habit.

Acute Opium Poisoning

Acute opium poisoning usually results from an overdose given medicinally, or when a preparation is taken with suicidal intent. Old people or children are very susceptible to morphine.

Symptoms

Since the most striking effect of opium is sleep, the symptoms are divided into three stages, according to whether the patient **can be aroused** from the sleep, whether he **can be aroused with difficulty** (**stupor**) or whether **he cannot be aroused at all** (**coma**).

Symptoms of the First Stage

1. **Slow, shallow breathing.** (This frequently occurs from an ordinary dose.)
2. Slow, strong pulse.
3. Flushed face.
4. **Contracted pupils.**
5. Profuse perspiration.
6. Sluggish mentality, inattentiveness, perhaps sleep.

If a very large dose has been taken, these symptoms may last for a very short time, or they may be absent entirely, and are soon followed by—

The Second Stage or Stage of Stupor

1. **The sleep is very deep,** and the patient can be aroused only with great difficulty. If spoken to in a loud voice, or when he is shaken and his attention attracted, he may brace up for a few minutes; but he soon falls asleep again.
2. **The breathing is very slow and shallow,** about 4 to 10 times a minute.
3. The pulse is slow and strong.
4. **The pupils are contracted** ("**pin point pupils**" **because they are very small**).
5. The skin is blue (cyanotic), because the blood does not get enough oxygen on account of the slow and shallow breathing.
6. The skin is covered with perspiration.

These symptoms last for a short time, and the patient soon passes into—

The Third Stage or Stage of Coma

1. The patient now lies in a very deep sleep, from which he cannot be aroused.

2. The breathing is very slow and shallow, about 3 to 4 times a minute. It often becomes periodic: a few moments of breathing alternating with periods of absent breathing (Cheyne Stoke's Respiration).

3. The pulse is rapid and weak.

4. **The skin is blue** (cyanosis).

5. **Pin point pupils.**

The breathing finally becomes still slower, the pupils dilate, and the patient dies from paralysis of the respiration, though the heart may beat for several minutes afterwards.

Synopsis of Poisonous Effects

The following are characteristic symptoms of acute opium or morphine poisoning:

1. Sleep, stupor, followed by coma.
2. Slow and shallow breathing.
3. Slow pulse.
4. Contracted pupils, "pin-point pupils."
5. Cyanosis.
6. Profuse perspiration.

Treatment

1. Wash out the stomach, with plain water, or better still, with a 1–2000 potassium permanganate solution, which makes the drug inactive. The washing should be repeated every half hour until the patient is entirely out of danger. Even if the drug is given hypodermically, the stomach should be washed out, as the drug is excreted into the stomach, and repeated washings help to eliminate it.

2. If the stomach cannot be washed out, for lack of apparatus, etc., or if a solid preparation has been taken, emetics should be given repeatedly, about every 15 minutes.

A tablespoonful of mustard in a glass of water, zinc sulphate 0.6–2.0 gms. (grs. x–xxx), copper sulphate 0.3–0.6 gm. (grs. v–x) may be given to produce vomiting, and potassium permanganate to destroy the drug.

3. **Atropine,** gr. $\frac{1}{100}$, is given. This is the antidote for morphine. It should be repeated every hour until the breathing becomes deep and rapid again. It should never be given without the doctor's orders, however, as atropine poisoning may result from its injudicious use.

4. Apply cold douches on the skin, rub or strike the patient with wet towels. This keeps him awake and increases the breathing. Care must be taken, however, not to cause exhaustion by too violent measures.

5. Keep the patient warm.

6. Catheterize.

7. Keep up artificial respiration continuously.

8. Respiratory stimulants, such as caffeine, or a hot coffee enema, strychnine, etc., are given and should be frequently repeated.

9. The application of the faradic current to the Vagus nerve in the neck may help the respiration in some cases.

Artificial respiration may be given by means of a specially constructed apparatus used for giving anaesthesia. (Meltzer Auer method.) By this method air is pumped into the lungs through a catheter inserted into the larynx.

The treatment of opium poisoning should be kept up for hours, as long as the patient is alive. Patients have recovered from as much as 2.0 gms. (grs. xxx) of morphine, by persistent treatment.

Chronic Opium Poisoning or Opium Habit

The opium habit occasionally results in patients to whom it has been necessary to give opium or morphine for a long time. The pleasant effects of the drug and the ease with which it relieves pain and suffering often induce the habit. The drug is usually taken in the form of opium pills or laudanum. Hypodermic injections of morphine is one of the

commonest ways in which the drug is taken. In China and India, the crude opium is smoked by many people. Opium habitués may take as much as 300 grs. of opium without causing dangerous symptoms.

The largest dose which a habitué can absorb is ʒi. If he takes more than that the excess is usually eliminated.

Symptoms

The characteristic symptom is the great craving for the drug. The other symptoms vary according to whether the patient is **without his drug** or **under the influence** of his usual dose.

When the habitué is not under the influence of the drug he usually has profuse sweating followed by abdominal cramps, twitching of the muscles and uncontrollable yawning. He is irritable and nervous. He is unable to do his work because he cannot concentrate his mind on anything.

When he gets his usual dose these symptoms disappear; he braces up, becomes energetic and is able to work, and he then feels quite comfortable. Many habitués have no other effects. Usually, however, the devotee passes into a drowsy, dreamy state during which he has so much pleasure that he forgets—his physical pains, his cares, his worries, even his responsibilities. He lives in a world of his own, where all sorts of pleasurable incidents occur. He may get brilliant ideas but is powerless to carry them into effect. Many lie in this state for hours and fall into collapse when they attempt to get up. Finally, the habitué falls into a deep sleep lasting for several hours, and gradually awakes with headache, nausea and weakness.

Prolonged use, however, ultimately undermines both body and mind. The individual becomes thin and anaemic. He has a loss of appetite and various other digestive disturbances. He is usually very constipated although he may have attacks of profuse diarrhoea. He becomes dull and listless, with no self control, no ambition and with no sense of truth or honor. Morphine habitués are most inveterate liars and cannot be trusted. Many of them develop all sorts of de-

praved moral tendencies and others become maniacal or insane.

They usually have a regular pulse, contracted pupils and irregular temperature. The arms may be full of needle marks and occasionally an abscess develops from the use of unsterilized needles.

The habit is treated by gradually withdrawing the drug, the administration of drastic cathartics, and hyoscine as an antidote. Stopping the drug suddenly may cause collapse.

What Can the Nurse Do to Prevent the Habit?

There is no condition more pernicious than the opium habit, because the habitué becomes a useless member of society. The frequency of the habit is indeed surprising. It is claimed that in New York City, in spite of the present stringent legislation, there are about 100,000 habitués. The administration of morphine for the relief of pain may be the beginning of a condition that may ultimately lead into a most deplorable abyss.

The nurse should bear these facts in mind, therefore, in administering morphine or opium. Whenever the use of these substances is indicated, she should use them only after exhausting every art of her profession to relieve the pain or discomfort. If these measures are of no avail she may give the dose ordered; but the patient should on no account be informed of the nature of the medicine.

In incurable cases accompanied by severe pain and in recurring cancers we must resort to the use of morphine, but this should be done very gradually, lest the time be reached too soon, when even morphine is of no avail.

Uses

Opium or morphine is used for a great many conditions. In fact, there is hardly a condition or disease in which this drug is not useful. It is used principally:

1. To relieve pain. For this purpose it is the best and most reliable drug.

2. To produce sleep, especially when the patient is unable to sleep on account of pain.

3. To lessen peristalsis and produce constipation.

4. To check the secretions, except the sweat.

5. To lessen all forms of nervous excitement, such as delirium tremens, convulsions, tetanus, etc.

Administration

For rapid effects, morphine, given hypodermically, is the best preparation to use. Opium is better where constipation is desired.

Preparations

Opium

Solid Preparations

Powdered Opium (Opii Pulvis) — 0.03–0.12 gm. grs. ½–ii

This contains 12% of morphine.

Deodorized Opium (Opii Deodoratum) — 0.03–0.12 gm. grs. ½–ii

This contains 12% of morphine, but its odorous substances have been removed.

Pills of Opium (Pilulae Opii) — 1 pill

Each pill contains 0.06 gm. (gr. i) of powdered opium. These pills must be freshly made, as otherwise they accumulate in the stomach and cause poisonous effects.

Extract of Opium (Extractum Opii) — 0.015–0.06 gm. gr. ¼–i

This contains 20% of morphine.

Powder of Ipecac and Opium (Pulvis Ipecacuanhae et Opii) (Dover's powder) — 0.6 gm. grs. x

Each powder contains 0.06 gm. (gr. i) each of ipecac and opium, and 0. 5 gm. (grs. viii) of milk sugar (it contains 10% of opium). Dover's powder is taken at night in hot

lemonade; to break up a cold. It increases the perspiration very freely.

Troches of Licorice and Opium
(Trochisci Glycyrrhizae et Opii)
(Wistar's cough lozenges)

Each lozenge contains gr. $\frac{1}{2}$ of opium. It is used to lessen cough.

For Local Use

Opium Plaster
(Emplastrum Opii)

This contains 6% of opium.

Pantopon 0.005–0.02 gm. gr. $\frac{1}{8}$–$\frac{1}{3}$

This is a mixture of the hydrochloride salts of all the alkaloids of opium.

Liquid Preparations

Tincture of Opium 0.3–1.0 c.c. m. v–xv
(Tinctura Opii)
(Laudanum)

This contains 10% of opium.

Tincture of Deodorized Opium 0.3–1.0 c.c. m. v–xv
(Tinctura Opii Deodorata)
(McMunn's elixir)

This contains 10% of opium. It contains no narcotine, and no odorous principles, and is therefore more pleasant to take.

Camphorated Tincture of Opium
(Tinctura Opii Camphorata)
(Paregoric)

For Adults	4.0–16.0 c.c.	3i–iv	
For Children			
Under 1 year	0.06–0.3 c.c.	m	i–v
" 2 years	0.3 –1.0 c.c.	m.	v–xv
" 3 "	0.3 –1.3 c.c.	m.	v–xx
" 5 "	0.3 –1.6 c.c.	m.	v–xxv
" 10 "	1.0 –2.0 c.c.	m.	xv–xxx

Paregoric contains 0.12 gm. (grs. ii) of opium to 30.0 gms. or (3i), together with camphor, benzoic acid, oil of anise and glycerine. It is the best preparation of opium to use for children.

Tincture of Ipecac and Opium 0.3–1.0 c.c. m. v–xv
(Tinctura Ipecacuanhae et Opii)
(Tincture of Dover's powder)

This contains 10% of opium.

Wine of Opium 0.3–1.0 c.c. m. v–xv
(Vinum Opii)

This is flavored with cinnamon and cloves.

Acetum Opii 0.3–1.0 c.c. m. v–xv
(Black drop)

This is opium extract with dilute acetic acid.

Mistura Glycyrrhizae Composita 15.0–30.0 c.c. ʒ ½–i
(Brown's mixture)

This contains 1 part of opium in 1000 of the mixture. It consists of paregoric, licorice, wine of antimony, and spirits of nitrous ether. It is used to lessen cough.

Compound Tincture of Opium 4.0 c.c. ʒ i
(Tinctura Opii Composita)
(Squibb's diarrhoea mixture)

This contains tincture of opium, tincture of capsicum, spirits of camphor, chloroform and alcohol.

ALKALOIDS OF OPIUM

Morphine

The effects of opium are due principally to the morphine which it contains.

The effects of morphine differ slightly from those of opium in the following ways:

1. Morphine is much more rapidly absorbed, and therefore acts more rapidly.
2. It can be given hypodermically.
3. It does not increase the secretion of sweat as much as opium.
4. It is not as constipating as opium.

Preparations

Morphine 0.008–0.03 gm. gr. ⅛–½
(Morphina)

Morphine Sulphate (Morphinae Sulphas)	0.008–0.03 gm.	gr. $\frac{1}{8}$–$\frac{1}{2}$
Morphine Hydrochloride (Morphinae Hydrochloridum)	0.008–0.03 gm.	gr. $\frac{1}{8}$–$\frac{1}{2}$
Compound Morphine Powder (Pulvis Morphinae Compositus) (Tully's powder)	0.3 –1.0 gm.	grs. v–xv

This contains morphine sulphate, licorice powder, and camphor.

Magendie's solution of morphine (not official).

This is a 1 to 30 solution of morphine sulphate (or grs. xvi to the ounce). This is a solution which is very commonly used for hypodermic administration. It should always be fresh, as a fungus often grows in old solutions, and makes it unfit for use, or it may change the morphine to apomorphine.

Morphine Meconate (Morphinae Meconas)	0.008–0.03 gm.	gr. $\frac{1}{8}$–$\frac{1}{2}$

Codeine

Codeine, one of the active alkaloids of opium, is a compound of morphine (methylmorphine). Its effects are similar to those of morphine, with the following differences:

1. It does not produce sleep as readily as morphine, and the sleep is very light.
2. It does not slow the breathing as much as morphine, and is therefore safer.
3. It does not produce constipation.
4. It is not so apt to induce the habit.

Preparations

Codeine (Codeina)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i
Codeine Sulphate (Codeina Sulphas)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i
Codeine Phosphate (Codeina Phosphas)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i
Eucodin (Methyl Codeine Bromide)	0.06 gm.	gr. i

This is used like codeine, to lessen coughing, but it is said to increase the secretion of mucus.

Narcotine causes muscular twitchings, and **thebaine** acts like strychnine, causing convulsions. Both of these alkaloids are not used in medicine.

Artificial Alkaloids of Morphine

The following alkaloids are made artificially, by the action of various chemical substances on morphine.

Dionine

Dionine is an artificial alkaloid made from morphine (ethyl morphine).

Its effects are similar to those of codeine. It is safer than morphine. It is used to produce sleep and relieve pain. It does not contract the pupil.

Preparations

Dionine (**Dionina**)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i

Peronine

Peronine is a substance which has the same effects as dionine. It is given in the same doses.

Heroin

Heroin is an artificial alkaloid made from morphine by its combination with an organic salt of acetic acid (diacetyl morphine hydrochloride). Its effects are similar to those of morphine with the following differences:

1. It makes the breathing slower than morphine does.
2. It is used principally to lessen coughing. It does not produce sleep as easily.

Recently the heroin habit has become very common, because of the difficulty in obtaining morphine. The heroin is usually taken by snuffing heroin powder up into the nose. The symptoms are like those of the morphine habit.

Preparations

Heroin (Heroina)	0.0025–0.01 gm. gr. $\frac{1}{24}$–$\frac{1}{6}$
Heroin Hydrochloride (Heroinae Hydrochloridum)	0.0025–0.01 gm. gr. $\frac{1}{24}$–$\frac{1}{6}$

CANNABIS INDICA (INDIAN HEMP)

Cannabis indica is a resinous substance obtained from the flowers of the **Cannabis sativa** or Indian hemp, a plant growing in India, Egypt, and the southern part of the United States.

It is used as an intoxicant in various forms in most of the Eastern countries. In India, the dried plant is used for smoking, either alone or with tobacco, and is called **gunjah** or **bhang. Churrhus** or **hashish** is an intoxicating drink containing the resinous juice, which is used in Arabia and Egypt. The resinous substance is often flavored with sugar or honey, and made into a confection. The active principle of cannabis indica is said to be a red oil or resin called **cannabinol.**

Appearance of the Patient

About a half to one hour after giving an average dose of a reliable preparation of cannabis indica, the patient feels drowsy, the sense of pain is lessened, the extremities feel numb, the patient often complains of noises in the ear, and he soon falls into a deep sleep, lasting several hours, from which he usually awakes refreshed. During the sleep, he may have particularly vivid beautiful dreams. The pulse and breathing are normal and the pupils are dilated. Occasionally he may be somewhat exhilarated before falling asleep.

ACTION

Cannabis indica produces no local effects.

Internal Action

When given internally it has a peculiar taste. It produces no effect in the stomach and the intestines, but is rapidly

absorbed into the blood; from the stomach, and it then acts principally on the brain.

Action on the brain: Cannabis indica lessens the appreciation of the various sensations, such as pain, touch, etc. In this way, **it relieves pain and produces sleep.**

It lessens the higher intellectual functions such as reasoning and judgment and also the sensory areas of the brain, while increasing the imagination. This accounts for the relief from pain and the characteristic vivid dreams. It dilates the pupil.

Effects of Large Doses

When cannabis indica is taken in large doses, or when it is smoked, it usually produces a characteristic state of pleasure and exhilaration which accounts for its frequent use as an intoxicant.

Very soon after taking a large amount of hashish, the individual passes into a drowsy state, during which he has the most beautiful dreams, and forgets everything—cares, worries, troubles, events which occur about him, even the individuals about him. He has visions of the most gorgeously beautiful scenes, amidst which he imagines all sorts of romantic incidents. He is usually joyful and happy, and seems to be in a garden of paradise far more beautiful than every previous conception of it.

These dreams are more marked in the languid oriental people. Europeans or Americans, unless they are particularly emotional, usually do not have such extravagant dreams, but merely become joyful and happy.

During this state of exhilaration, ideas arise so rapidly, that time seems to pass much faster than it actually does. Events which usually last hours seem to occur in several minutes. This state of exhilaration lasts for a short time, perhaps an hour, and the patient then falls into a normal, quiet sleep from which he can be readily awakened. Often the individual has a sense of impending death. Occasionally it causes a feeling of a dual personality; that is, the devotee feels as if he were two different persons at the same time.

The pulse is perhaps a little stronger and faster, the breathing is normal, and the pupils are dilated.

In India, the natives often produce a state of catalepsy (stiffening of all the muscles) by means of hashish.

Uses

Cannabis indica is used to relieve pain and to produce sleep as a substitute for morphine, in neuralgia, painful menstruation, chorea, hysteria, etc. It is an unreliable drug, however, as many of its preparations are inactive. Preparations made from plants grown in warm climates are usually better.

Preparations

Extract of Cannabis Indica (**Extractum Cannabis Indicae**)	0.015–0.06 gm.	gr. $\frac{1}{4}$–i
Fluidextract of Cannabis Indica (**Fluidextractum Cannabis Indicae**)	0.1 –0.3 c.c.	m. i $\frac{1}{2}$–v
Tincture of Cannabis Indica (**Tinctura Cannabis Indicae**)	1.0 –2.0 c.c.	m. xv–xxx

Lactucarium

Lactucarium is the dried, milky juice obtained from the **Lactuca virosa**, or garden lettuce. It is occasionally used as a substitute for opium, to relieve pain and produce sleep. It is given in the form of a tincture, in doses of 0.6–4.0 gms. (m. x–3i) or as a syrup.

Other Analgesics

The coal tar drugs or the Analgesic Antipyretics are used principally for the relief of nervousness and headache but they also slightly relieve pain. They were originally used to reduce temperature. The following are the coal tar substances most commonly used:

Antipyrine
Acetanilid
Phenacetine
Pyramidon
Aspirin

There are several other drugs which contain alkaloids which act like morphine in very small amounts. The following are the most common substances used:

Sanguinaria Canadensis or Blood Root
Chelidonium Majus or Celandine

GENERAL CEREBRAL DEPRESSANTS

THE BROMIDES

The bromides are crystalline salts formed by the combination of an alkali, such as potassium, sodium, ammonium, etc., with hydrobromic acid. This is an acid formed from bromine, an element found in sea water.

(Every salt consists of two parts: the part derived from the alkali, which is called the base; and the part derived from the acid, which is called the acid radicle. For example, in potassium bromide, the potassium is the base, and is derived from the alkali. The bromide is the acid radicle and is derived from the acid. Every salt when in solution is decomposed into two or more electrical, readily absorbable elements, or ions, as they are called. Each of these ions produces separate and different effects.)

The effects of the bromide are due principally to the acid radicle, or bromide ion. The base of the salt also produces some effects. Each of the various bromides, therefore, produces a somewhat different effect because of the different base with which it is combined.

Potassium bromide is a salt formed by the combination of potassium, and hydrobromic acid, or by some of their salts. It is the most active salt of the bromides, and is the preparation commonly used.

ACTION OF THE BROMIDES

Appearance of the Patient

About 15 to 20 minutes after an average dose of one of the bromides is taken, the patient complains of a dull headache, he feels tired and weak, and does not care to exert him-

self, either mentally or physically. When he moves about, the movements are slow and languid. He perceives objects about him, though not as clearly as usual, but he manifests no interest in them. He speaks slowly and hesitatingly, in a monotonous tone of voice. He does not express his thoughts clearly; these are slow and confused, and his reasoning and memory are poor. Very often the patient becomes drowsy. The pulse is somewhat slower and weaker, and the breathing is somewhat slower.

If the patient is nervous and excitable, he becomes calm and quiet. If he has tremors or convulsions, these are lessened or prevented from recurring.

ACTION

Local action: Applied to the skin, the bromides produce no effects. **Mucous membranes,** however, are made somewhat less sensitive.

Internal Action

In the mouth: The bromides have a salty taste and they make the throat less sensitive, so that when it is touched, vomiting is not so apt to occur.

In the stomach and intestines: No effect is produced except occasional nausea.

Action after Absorption

The bromides are absorbed through the mucous membrane of the stomach and intestines, usually in a few minutes. They are also readily absorbed from all mucous membranes. After absorption, they affect principally the nervous system.

Action on the nervous system: The bromides lessen the activity of the entire nervous system: the brain, the spinal cord and the nerves.

Action on the brain: The activity of the motor areas of the brain is lessened, so that they send out fewer impulses for motion. The patient then moves about slowly and languidly; he does not care to exert himself. Twitchings of the muscles and muscular contractions are lessened.

The activity of the speech area of the brain is lessened. The impulses for speech are then sent out more slowly. This makes the speech slow, hesitating, often indistinct and its tone monotonous.

The sensory areas of the brain are made less active. The patient then sees, hears, and feels objects less distinctly, and the appreciation of pain is lessened. The impressions received by the brain through these various senses, are therefore not very vivid. The patient does not manifest much interest in the objects or activities about him. Since the sensory impressions are less readily received by the brain, consciousness is lessened, and the patient becomes drowsy, or even falls asleep.

The mental activities of the brain are lessened, the memory is indistinct, and the reasoning is poor. Ideas do not arise easily. All the emotions are especially lessened; so that a nervous, hysterical, emotional individual, often becomes calm and quiet. This helps to produce sleep in such individuals, who often suffer from sleeplessness because of their nervousness.

The headache which is often produced by bromides, is due to the strain that ordinary activities of the brain produce in patients under the influence of these drugs.

Action on the spinal cord: The bromides lessen the activity of the spinal cord. The reflex action of the body is therefore lessened. The patient does not then respond readily to external stimuli applied to the skin or mucous membranes. For example, when the conjunctiva of the eye is touched, winking results very slowly. When the pharynx is touched, vomiting is not produced so easily. The bromides also lessen the sexual reflexes.

Action on the nerve endings: The bromides make the sensory nerve endings less sensitive. The patient does not then appreciate the various sensations clearly.

All the foregoing effects on the nervous system, are due to the bromide part of the salt, and result from any bromide salt, such as sodium, potassium, etc.

Action on the heart: The bromides makes the heart beat slower and weaker, especially when it is overacting, causing

a slow, weak pulse. This effect occurs principally from potassium bromide and is due largely to the potassium or basic part of the salt. The other bromides do not affect the heart as much.

Action on the respiration: In ordinary doses the bromides may lessen coughing. Large doses make the breathing slow and shallow.

Effect on temperature: Owing to the lessened activity of the various organs of the body, the temperature is slightly lowered, because less heat is produced.

Excretion

The bromides are very slowly eliminated from the body, mainly by the kidneys, the skin (through the sweat glands), and by all the mucous membranes. It usually takes about 24 to 72 hours for the bromides to be entirely excreted, often even weeks and months.

Poisonous Effects

Acute poisoning from the bromides does not occur. Since they are rapidly absorbed, but very slowly excreted, when administered continually for a long time the bromides may accumulate in the body, and cause cumulative symptoms, or "bromism."

Symptoms of "Bromism"

The symptoms may appear gradually or suddenly. They are due principally to the exaggerated effects of the bromides, and to the effects on the various tissues and organs through which they are excreted. For example, the rashes which occur, are due to the excretion of the drug through the skin.

1. **Skin eruptions.** These consist principally of groups of pimples on the face (acne); frequently small abscesses form in the skin. At other times, there are reddish spots scattered over the skin, and the skin may be very pale.

2. Loss of appetite, salty taste in the mouth, bad breath, and disturbed digestion.

3. Constipation.
4. Drowsiness.
5. Stupid, dull expression on the face.
6. Depressed spirits, even melancholia.
7. The eyes look heavy and dull.
8. The patient manifests no interest in his surroundings.
9. Slow, uncertain gait.
10. Slow, stammering speech, often words are forgotten and mispronounced.
11. Very poor memory, even recent events are forgotten.
12. Slow pulse.
13. Lessened reflexes (touching the conjunctiva of the eye does not cause winking, etc.).

Treatment

When the bromides are stopped, the symptoms gradually disappear. Giving cathartics and hot baths helps to eliminate the drug more easily.

Comparative Action of Bromides

Potassium bromide is the most active salt, but in large doses it may weaken the heart action and cause a slow weak pulse.

Ammonium bromide may make the pulse and breathing faster.

Lithium bromide is apt to upset the stomach. It is said to increase the flow of urine.

Uses

The bromides are used to lessen overactivity of the brain in the following conditions:

1. To prevent epileptic convulsions.
2. To relieve the muscular twitchings of chorea ("St. Vitus' dance").
3. To relieve emotional conditions, nervousness or excitability, in neurasthenia.

4. To produce sleep when the insomnia is due to nervousness.

5. To lessen sexual excitement.

Preparations

Potassium Bromide (Potassii Bromidum)	1.0–4.0 gms.	grs. xv –℥i
Sodium Bromide (Sodii Bromidum)	1.0–4.0 gms.	grs. xv –℥i
Ammonium Bromide (Ammonii Bromidum)	1.0–2.0 gms.	grs. xv –xxx
Lithium Bromide (Lithii Bromidum)	1.0–2.0 gms.	grs. xv –xxx
Strontium Bromide (Strontii Bromidum)	2.0–4.0 gms.	grs. xxx–℥i
Calcium Bromide (Calcii Bromidum)	2.0–4.0 gms.	grs. xxx–℥i
Dilute Hydrobromic Acid (Acidum Hydrobromicum Dilutum)	2.0-12.0 gms.	grs. xxx-℥iii

This is a 10% solution of hydrobromic acid. About **7.0** c.c. of this solution is equal to 1.0 gm. of potassium bromide.

Monobromated Camphor (Camphora Monobromata)	0.3–0.6 gm.	grs. v–x

This preparation is used to lessen the excitement of hysteria, neurasthenia and sexual excitement. Its effect is due mainly to the camphor.

New and Non-official Preparations

Adalin	0.3–0.6 gm.	grs. v–x

This is an organic bromide salt (brom diethyl acetylcarbamide). It produces the same effects as the other bromides.

Brometone	0.3 gm.	grs. v

This is an organic bromide salt (acetone bromoform), which is said not to cause cumulative symptoms.

Bromipin or Bromiol	1.3–10.0 gms.	grs. xx-cl

This is a combination of bromine and sesame oil. It

usually comes either in a 10 or 33⅓% solution. It is claimed that it will not cause cumulative symptoms. It is given in syrup flavored with peppermint water.

Bromo Mangan 4.0–16.0 c.c. ʒ i–iv

This is a compound of iron, manganese, bromine and peptones. It contains about 11% of bromine. It is used to soothe nervousness and to build up nervous patients.

Brovalol 0.25–0.75 gm. grs. iv–xii

This is a compound of a valeric acid salt and bromine. It is used to soothe nervous patients, and is said to be more effectual than either the valerian preparations or the bromides alone.

Sabromin 0.5–4.0 gms. grs. viii–ʒi

This is an organic salt formed by the combination of calcium and dibrombehenic acid. It produces the same effects as the other bromides, but they come on slower and last longer. It is said to have a more pleasant taste and not to upset the stomach. It usually comes in tablets, each containing 0.5 gm. (grs. viii).

The following preparations of the bromides are occasionally used:

Bromocoll 2.0–4.0 gms. ʒ½–i

This contains about 20% of bromine, gelatin and tannic acid.

Bromidia

This contains potassium bromide, chloral hydrate, extract of hyoscyamus, extract of cannabis indica, licorice and oil of orange peel.

PROGRESSIVE CEREBRAL DEPRESSANT

ALCOHOL (ALCOHOL ETHYLICUM)

Alcohol is a colorless fluid which evaporates very quickly. It has a pungent odor, and a burning taste. It burns very easily with a blue flame, and it is often used for heating purposes.

Alcohol is formed by the growth of the yeast plant,

(a vegetable organism) in a solution of fruits or vegetables containing sugar. This process is called **fermentation.** Starchy fruits or vegetables also produce alcohol on fermentation, because the starch is changed to sugar, which is then fermented by the yeast. The growth of the yeast plant changes the sugar to alcohol and carbon dioxide.

Some alcoholic preparations are made by **distillation.** The fermented fruit, rye or corn is heated in a large vat. Since the alcohol evaporates very easily, it turns to vapor when it is heated. The vapor then passes along a series of tubes into a cool receptacle, where the vaporized alcohol again becomes fluid. Distilled liquors are made in this way.

Appearance of the Patient

After an ordinary dose of any alcoholic liquor, such as whiskey or wine, the patient usually becomes cheerful, is satisfied with himself, his surroundings, and those about him. He is perhaps more active and more talkative. The face is flushed, the eyes are bright and there is a feeling of warmth. The pulse is rapid and bounding and the breathing is deeper.

ACTION

Local action: Applied to the skin, alcohol causes redness and itching. It hardens the skin, checks the sweat and acts as an antiseptic. Because it evaporates quickly, it makes the skin feel cold. If its evaporation is prevented, however, or if the skin surface is injured, it becomes red, painful and swollen (irritation).

On mucous membranes: It causes a burning sensation and contracts the cells of the mucous membrane.

Internal Action

In the mouth: Alcohol has a burning taste, it increases the flow of saliva, reddens and contracts the lining membrane of the mouth. Strong preparations, such as whiskey, often cause a burning sensation in the throat; and, on account of the fumes which it produces, they cause a fit of coughing, and a flow of tears from the eyes and nose.

In the stomach: Small quantities of weak alcoholic drinks,

such as beers or wines, aid the appetite, increase the secretion of gastric juice, and the peristaltic contractions of the stomach.

In the intestines: By the time alcoholic drinks reach the intestines they are so weak that they do not cause any effects. In excessive doses they may cause mild bowel movements. Some preparations, such as brandy, check diarrhoea.

Action after Absorption

Alcohol is very rapidly absorbed, usually in about fifteen minutes. Most of the alcohol enters the blood through the lining membrane of the stomach, but a small part passes through the mucous membrane of the intestines.

After absorption alcohol affects principally the circulation, the respiration, and the brain.

Action on the Circulation

The effects of alcohol on the circulation are **reflex** and **direct.** The reflex effects occur from the local action on the mucous membranes and appear before the alcohol is absorbed. The direct effects occur after absorption.

Immediate reflex effects: Almost immediately, but evanescently, after taking or injecting alcohol the heart beats faster and somewhat stronger, causing **a rapid bounding pulse** with an increase in blood pressure. At the same time the skin becomes flushed by dilatation of its blood vessels.

These effects are the result of the local redness and slight swelling (irritation) in the mouth or at the site of injection, which cause impulses to be sent to the medulla of the brain. The medulla responds to these impulses by sending other impulses to the heart to make it beat faster and stronger, and to the blood vessels to make them dilate.

Effects after absorption. After absorption alcohol makes the heart beat slightly stronger and faster. It increases the contractions of the heart muscle and lessens the impulses sent from the medulla to slow the heart.

In large doses it lessens the contractions of the heart muscle.

In weakened conditions alcohol may act as a food, supply-

ing the heart with energy and thus increasing its muscular contractions.

Action on the respiration: Alcohol makes the breathing deeper and more rapid.

Action on the Nervous System: Alcohol progressively lessens the action of the brain. It begins by affecting the highest intellectual activities, such as will power, judgment, reasoning. It then affects the motor and sensory functions. Finally it lessens the action of the entire brain and of the medulla as well.

The effects on the brain are usually noticed only after taking large quantities of alcoholic drinks. The individual becomes self confident of both his physical and mental powers, often over confident. He becomes more active and moves about energetically. He is more talkative, but his speech is not as careful as usual. His ideas are not as clear nor as logical and his choice of words and sentences may be poor. He is usually more coarsely emotional; he becomes quite jolly and he may laugh or cry.

From larger quantities, the lessened brain action becomes progressive and more apparent. The movements become incoördinated and staggering. He forgets or repeats words and sentences. Finally his movements cease, and stupor and coma soon follow.

Although the symptoms that result from large doses of alcohol are apparently those of increased brain activity; and this is the view held by some, the general consensus of opinion, based on actual psychological experiments is that they result from lessened brain activity.

The normal civilized individual is under constant restraint, his thoughts, his speech, his acts, even his muscular movements have been so regulated and sensitized by training and intellectual development that his actions follow certain standards.

Alcohol begins by removing this normal restraint. The over confidence in the ability to do, what the individual is manifestly unable to do, the uncalled for movements, the incoherent speech, the coarse emotions, all bespeak a removal of restraint or inhibition. It is evidently the result

of lessening the action of the most highly developed and the most recently acquired mental functions of the brain. In other words, the effects of civilization are suddenly removed, the individual's actions approach those of uncivilized barbarians, whose mentality is of a low grade.

The removal of the normal restraint accounts for the greater play of the purely physical motor functions of the brain. But even these actions do not occur in a systematized coördinated normal fashion, as is evident from the *boisterous* laughter, the *uncalled for* tears, the apparently purposeless, *staggering* gait. The terminal muscular relaxation, the stupor and coma are conclusive effects of lessened brain action.

Effect on temperature: Alcohol lowers the temperature because the dilated blood vessels of the skin make the body lose heat.

Effect on nutrition: Alcohol has a distinct food value. About 90% of the alcohol absorbed is used up in the body. It combines with oxygen and is changed to carbon dioxide and water. In this way it provides energy for the activity of the body cells. It is able, therefore, to take the place of such foods as carbohydrates (starches, sugars) and fats.

It is only suitable for temporary use, however, as in fevers; because if given for a long time, alcohol injures the various organs and tissues of the body. This may neutralize any effect it may have as a food.

Action on the kidneys: Alcohol slightly increases the flow of urine.

Excretion

About 90% of every dose of alcohol given is used up in the body. The rest is rapidly eliminated by the kidneys, the lungs, and the skin, in the urine, the expired air, and the sweat.

Acute Alcoholism

Acute alcoholic poisoning results from drinking alcoholic liquors to excess. The effects constitute the familiar and far too common picture of drunkenness.

Symptoms

The effects may be divided into two stages: The stage of

excitement, in which all the higher functions of the brain are lessened and the stage of stupor when all the brain actions are diminished.

Excitement Stage

The excitement may be increased and is often due to the brilliant surroundings in which alcoholic drinks are usually indulged. They may be entirely absent when taken under less inspiring conditions.

The individual is usually talkative; his thoughts flow freely, perhaps too freely. The speech may be brilliant, but it is careless, loud, coarse and incoherent. It is not logical and there is a poor choice of words or sentences. The words themselves may not even be spoken distinctly. The individual is usually jolly, boisterous and may suddenly become angry and quarrelsome. He may burst into a fit of tears or laughter. He often becomes coarsely sentimental and sensual. He usually moves about in an undignified manner but his gait soon becomes unsteady and staggering. The face is usually flushed and the pulse and breathing are rapid.

When larger quantities are taken, the staggering gait becomes very marked, nausea and vomiting occur and the patient passes into—

The Stage of Depression

The individual now falls into a deep sleep from which he can only be awakened with great difficulty (stupor). All his sensations are lessened and he may not feel pain. His muscles are relaxed; and this frequently saves him from a fracture after a severe fall. His face is blue, the breathing is slow and snoring in character (stertorous) and the pulse is rapid, strong and bounding. Frequently there is loss of control of the rectum and bladder.

When awakened he is usually dull and stupid and falls limply back with a thud. Finally he passes into a condition of coma (a deep sleep in which he cannot be aroused) and collapse; with a rapid, weak, thready pulse and dies.

The effects of overdoses of alcohol vary with different individuals. Some become sentimental, others quarrelsome,

and still others fall asleep and have no excitement stage at all.

Fatal results have occurred from a dose of 500 c.c. (1 pint) of whiskey.

Treatment

1. Wash out the stomach.
2. Give artificial respiration if the breathing is slow and shallow.
3. Apply cold applications to the head.
4. Keep the patient warm.
5. Stimulants, such as strychnine, caffeine or a hot coffee enema are usually given.

Chronic Alcohol Poisoning, "Alcoholism"

Chronic alcohol poisoning results from habitually taking alcoholic liquors, especially distilled liquors, such as whiskey, gin, etc., which contain large percentages of alcohol. Rarely, the symptoms result from habitually drinking beers or wines.

The injurious effects of alcohol are due to the fact, that when taken habitually, it dissolves some of the substances in the functionating cells of the various organs of the body. As a result, many of these cells are destroyed, and replaced by connective tissue, which is not an active part of an organ. The organ thus affected is then unable to perform its work as well as before, and the patient suffers from various symptoms as a result of it.

The organs usually affected are the stomach, the liver, the blood vessels, the nervous system, and the kidneys.

The stomach is affected by habitual alcoholism. Many of the cells of its lining membrane are destroyed, their place being taken by connective tissue, and **chronic gastritis** results. The secretion of gastric juice is then diminished and the patient suffers from various digestive disturbances.

The secretion of mucus from the stomach is increased, the patient's tongue is dry and brown, and he usually complains of pain in the region of the stomach. Often he has nausea and vomiting in the morning.

The liver is also frequently affected. Some of its cells

being destroyed, and replaced by connective tissue, a condition known as cirrhosis of the liver results. This makes the liver very hard and interferes with its circulation. The patient then often develops fluid in the abdomen from accumulation of the blood in the abdominal vessels, and also suffers from digestive disturbances.

The arteries become hardened by habitual alcoholism, because there is more connective tissue formed in their walls. This condition is known as **arteriosclerosis.** The patient then suffers from various symptoms as a result of the disturbed circulation in various organs, the blood pressure is very high, patients have continual headache, and numerous other symptoms.

The heart may also be affected by alcohol. Many of its muscle fibers are destroyed and replaced by numerous areas of connective tissue. Disturbed heart action, often weakened heart action (myocardial insufficiency) may subsequently result.

The kidneys are very frequently affected; connective tissue replacing the cells which have been destroyed. The patient then suffers from chronic nephritis (Bright's disease). Small quantities of urine are passed; there may be oedema of the extremities, fluid in the tissues, etc.

Alcohol is particularly injurious to the nervous system. It destroys many of the cells of the gray matter of the brain. It is an important predisposing factor, often the cause, of various forms of insanity, of paralysis, and other disturbances of the nervous system.

The nerves are frequently affected by alcohol. Paralysis of the muscles of the arms and legs often result from the effects of habitual alcoholism (alcoholic multiple neuritis).

Other evidences of chronic alcoholism are a red nodular nose, dilated blood vessels of the skin, especially on the face, and waxy, dry, soft skin. The mind is often sluggish and weak.

Delirium Tremens

This is a special kind of temporary alcoholic insanity, which occurs in habitual drinkers, when they receive any

shock. This may be the result of an injury, haemorrhage, an infectious disease, or a surgical operation. The symptoms are due to the patient being deprived of his usual amount of alcohol.

The most common symptoms are **hallucinations of the various senses, abnormal fear, tremors of the muscles and excitement.**

The patient often sees various animals, such as snakes, rats, dogs, etc., before him (hallucinations of sight) or he feels them creeping upon him (hallucinations of touch). Often he hears voices and is constantly talking to those who seem to be speaking to him. The patient usually has twitching of the muscles of the extremities and is afraid of everybody about him.

Delirium tremens may be avoided by giving alcohol regularly to those patients who take it habitually; whenever they are subject to any shock, or when they have undergone a surgical operation.

Uses

Locally, alcohol is used for the following effects:

1. To harden the skin and prevent bed sores.
2. As an antiseptic; 50–70% alcohol is the best preparation for such use.

Internally, alcohol is used in the following conditions:

1. As a cardiac and respiratory stimulant in cases of fainting, shock and collapse. Whiskey and brandy are the preparations used for this purpose.
2. To check a cold after exposure, whiskey or brandy in hot water, relieves the congestion of the internal organs, by widening the vessels of the skin.
3. In acute infectious diseases, such as typhoid fever, septicaemia, pyaemia, whiskey may be given as a food, to reduce fever, to lessen nervousness and to induce quiet and sleep.

In such cases, the pulse will become slower, the temperature is lowered, the breathing becomes slower and deeper. The delirium and other nervous symptoms are lessened, and sleep is induced. The tongue becomes moist and the skin perspires more profusely.

When these effects are produced, alcohol is acting favorably.

When, however, the pulse becomes rapid, the delirium, restlessness, uneasiness, and other nervous symptoms, are increased; the sleeplessness increases and the tongue and the skin remain dry, the alcohol is acting unfavorably, and the symptoms should be reported to the physician.

4. In convalescence it is given as a food and for its soothing effect. In poisonous snake bite, alcohol, in the form of whiskey or brandy, should be given in very large doses.

5. Beer, brandy, or whiskey and water, may be given at bedtime to produce sleep, especially when the inability to sleep is due to mental work or nervous strain.

6. Brandy occasionally checks diarrhoea.

7. Dilute alcohol is a very valuable antidote for carbolic acid poisoning.

Tolerance

Individuals who take alcoholic beverages habitually, can take large quantities of such drinks without any of the usual poisonous symptoms being produced. This condition is known as tolerance for alcohol. To obtain effects in such individuals, much larger doses than usual must be given, often even more than twice the usual dose.

Administration

For local use the preparations of alcohol are used.

For internal use alcoholic liquors are principally used.

For temporary use and for immediate effects the distilled liquors, such as whiskey or brandy, are used.

They are best given hot, undiluted. Ordinarily, however, brandy or whiskey is best given diluted in a glass of vichy or seltzer filled with cracked ice, or with milk and egg in the form of a **milk punch** or **egg nogg**.

In collapse brandy and whiskey are frequently given hypodermically.

For continued use the fermented liquors such as wine or beer are used.

Preparations

For Local Use

Alcohol
(Alcohol)

This contains 95% of ethyl alcohol by volume, and 92% by weight. It is used for rubbing the skin, to prevent bed sores. It is also used for burning purposes in alcohol lamps.

Absolute alcohol
(Alcohol absolutum)

This contains 99% of ethyl alcohol. It is not ordinarily used, except by pharmacists and in laboratories.

Dilute alcohol
(Alcohol dilutum)

This contains about 50% of ethyl alcohol by volume and about 41% by weight. This is the best preparation to use for antiseptic use.

For internal use

Alcoholic Beverages

Distilled liquors

Whiskey 15.0 c.c. ℥ss
(Spiritus Frumenti)

This contains about 44 to 50% of ethyl alcohol by weight, and about 50 to 56% by volume. Whiskey is made by distilling fermented grain or other starchy plants. It should be at least four years old, because the fresh preparations are too injurious to the tissues.

There are several kinds of whiskey:

American whiskey, made by distilling fermented rye and corn.

Scotch whiskey, made by distilling fermented barley.

Irish whiskey, made by distilling fermented potatoes.

Brandy or Cognac 15.0 c.c. ℥ss
(Spiritus Vini Gallici)

This contains about the same percentage of alcohol as whiskey. Brandy is made by distilling fermented unchanged juice of fresh grapes. It should be at least four years old, because the fresh preparations are too irritating. There are two kinds of brandy: pale and dark. The dark brandy contains caramel.

Brandy or cognac contains small quantities of tannin. As a result, it has a tendency to contract mucous membranes. It is therefore more soothing to the stomach and intestines, and has a tendency to constipate and check diarrhoea.

Rum (not official) 15.0 c.c. ℥ss

Rum contains the same percentage of alcohol as whiskey. It is made by distilling fermented molasses.

Gin (not official) 15.0 c.c. ℥ss

Gin contains about the same percentage of alcohol as whiskey. It is made by distilling fermented rye, or barley, and flavoring with juniper berries. Because of the juniper which it contains, gin increases the flow of urine (diuretic).

Fermented Liquors

Wines

Wines are fermented liquors, made from grapes. Besides the alcohol, wines contain various acids, such as tartaric and tannic acids, and some volatile oils.

There are several kinds of wines:

White wines. **Red wines.** } **Dry** **Sweet** **Sparkling**

White Wine (Vinum Album)

White wines are made by fermenting grapes without the skins, stems or seeds. They contain 7 to 12% of alcohol.

Dry wines are those which contain no added sugar.

Sweet wines are those which contain sugar which has been added.

Sparkling wines are those which are bottled before fermentation is complete. They contain carbon dioxide gas, and effervesce.

The most important white wines are the following:

Dry white wines, such as rhine wines. They contain about 10% of alcohol.

Sweet white wines, such as tokay wines. These contain about 14% of alcohol.

Sparkling white wines, such as **champagne,** which is a French white wine. It is the most commonly used sparkling white wine and contains about 10% of alcohol.

Champagne should be given ice cold, in teaspoonful doses. It is particularly valuable in cases of nausea and vomiting, for example, after an operation.

Champagne is not so effective when the gas escapes. This may be avoided by inserting a special tap in the cork, and keeping the bottle on ice, upside down.

Red Wines (Vinum Rubrum)

Red wines are made by fermenting colored grapes with the skins. They contain a larger percentage of alcohol than the white wines.

Dry Red Wines:

Claret

This contains about 8–10% of alcohol.

Sherry (Vinum Xericum)

Sherry contains about 15–20% of alcohol and is often made artificially.

Port Wine (Vinum Portense)

This is the strongest red wine, and contains about 20–40% of alcohol.

Sweet Red Wines: The most commonly used sweet red wines are burgundy and madeira. They contain from 6–20% of alcohol.

Sparkling Red Wines: The most commonly used sparkling red wine is **sparkling burgundy,** which contains about 10% of alcohol.

Uses of Wines

The wines are not as stimulating as the distilled liquors, such as whiskey or brandy. They are better suited, however, for continued use. They aid digestion when taken during meals. Sweet wines, however are apt to disturb digestion.

The wines contain tannic acid and contract mucous membranes (astringent action). They are therefore more constipating than the distilled liquors.

Sparkling wines, such as champagne, are soothing to the stomach when given in small doses. They are not as stimulating to the heart. Champagne causes intoxication rapidly, in spite of the small quantities of alcohol which it contains. When taken in larger quantities it is apt to cause headache, pain in the stomach, nausea, hiccough, etc.

Beers

Beers are made by fermenting starchy grains. They are usually made by fermenting brewed barley malt (barley which has been made to grow by artificial means and the growth stopped), with hops.

Ale, porter and **stout,** are the various kinds of beers that are used. They contain about 3–10% of alcohol with a large amount of solids, mainly sugar and starches. Because of the starches and sugar which they contain, beers are very nutritious. They occasionally disturb digestion however.

Liqueurs are preparations of volatile oils containing alcohol. Many of them contain sugars. Kirchwasser is a liqueur which contains very small quantities of hydrocyanic acid.

Various essences of flowers, such as eau de cologne, contain large amounts of alcohol. Cases of alcoholism occasionally occur from drinking eau de cologne, especially among women.

WOOD ALCOHOL (METHYL ALCOHOL)

Wood alcohol is made by the destructive distillation of wood. It is very inflammable, and because it is cheap it is used as a solvent for various substances.

Wood alcohol is not used in medicine but it is of great interest because of its poisonous effects. These result from the fact that it is frequently substituted by unscrupulous manufacturers for ordinary alcohol in the manufacture of essences such as soda water flavors, Jamaica ginger, witch hazel, bay rum, cologne, etc. Many patent medicines contain wood alcohol. Since the advent of prohibition the number of cases of wood alcohol poisoning have greatly increased because many beverages are prepared with wood alcohol since it is so difficult to obtain ordinary alcohol.

Wood Alcohol Poisoning

There are two forms of wood alcohol poisoning; the acute poisoning and the chronic poisoning. The acute symptoms follow the drinking of intoxicating or other liquors containing wood alcohol. The chronic symptoms result from the continued use of local applications containing wood alcohol.

Acute Wood Alcohol Poisoning

Symptoms

The symptoms are due to the fact that wood alcohol is not oxidized in the body as is ordinary alcohol, but affects principally the brain and nerves.

The symptoms begin like an ordinary alcoholic intoxication with excitement and exhilaration. This is followed by:

nausea,
vomiting,
dizziness,
headache,
dilated pupils,
delirium.

Persistent coma and death within a few hours or a few days. The patient may recover from the acute symptoms but may go blind just the same from destruction of the optic nerve (optic neuritis). Blindness has resulted from as little as five teaspoonfuls and death from a half a pint of wood alcohol.

Treatment

1. Wash out the stomach.
2. Pour hot and cold water over the patient alternately.
3. Give artificial respiration.
4. Strychnine, caffeine and other stimulants are given.

Chronic Wood Alcohol Poisoning

Prolonged use of wood alcohol may cause blindness from destruction of the optic nerve (optic nerve atrophy). This may occur from its internal use or from external applications of various toilet preparations.

There are numerous other alcohols such as **propyl alcohol, butyl alcohol, amyl alcohol,** etc., which result in the distillation of ordinary wood alcohol.

CHAPTER XVIII

GENERAL ANAESTHETICS

Anaesthetics are drugs used to produce insensibility to pain, so as to enable a surgical operation to be performed painlessly. The anaesthetics are divided into two groups:

1. **General Anaesthetics**
2. **Local Anaesthetics**

General anaesthetics are drugs which produce insensibility to pain and a loss of all sensations throughout the body. No sensory impulses are then received by the brain, and the patient becomes unconscious and falls asleep. The effects of the general anaesthetics result from their circulation in the blood.

Local anaesthetics are drugs which abolish sensations only on the particular area of the body where they are applied. Since they do not abolish all sensory impulses, they do not produce unconsciousness.

In this chapter we shall consider only the general anaesthetics.

ETHER (AETHER)

Ether is a colorless liquid formed by the combination of sulphuric acid and alcohol. It evaporates very easily, is very inflammable and has a very disagreeable odor and a burning taste.

Ether was first used as an anaesthetic by an American dentist, Dr. Morton, in 1842.

It is usually given by inhalation through a mask or specially constructed apparatus, to produce insensibility to pain. Its effects are quite similar to those of alcohol, which was formerly used in excessive doses to produce a mild anaesthesia. Chemically, ether is closely related to alcohol, being formed when alcohol is combined with oxygen.

Appearance of the Patient

Ether Anaesthesia

The most striking effect that may be noticed when ether is given to produce anaesthesia, is that the patient struggles and talks a great deal. It is customary, therefore, to divide the anaesthetic effects of ether, into three stages; according to whether the effects occur before the patient struggles, during the time of struggling, or after this stage has occurred. The three stages of ether anaesthesia are the following:

1. **The stage of imperfect consciousness, or first stage.**
2. **The stage of excitement, or second stage.**
3. **The stage of anaesthesia or complete unconsciousness, or third stage.**

Symptoms of the First Stage of Anaesthesia

The patient has probably undergone various preparations for the operation, and has pictured in his mind various ideas of pain and suffering that the operation might produce. This makes him quite nervous and anxious, and the pulse quite rapid. He therefore regards every act of the doctor or nurse with suspicion. When the mask is applied to the face, the difficulty of obtaining air causes a **choking sensation,** and the inhalation of the ether causes a burning pain in the throat, which often makes him cough and causes a **profuse flow of saliva.** Soon there is a feeling of warmth all over the body and the sensations become dulled. **The sense of touch is blunted, objects are seen through a mist, and sounds appear to be at a distance.** Often **ringing, hissing or roaring sounds** are heard. The muscles become stiff and the arms are held rigid. **The face is flushed,** the pupils are dilated, but they react to light. The pulse is rapid, and the breathing is rapid and irregular on account of the coughing and choking sensation. These effects last for about five or ten minutes and are soon followed by—

The Symptoms of the Second Stage or Excitement Stage

This stage begins with **movements of the arms.** The patient tries to push the mask away, and attempts to get up. Many patients **struggle violently,** others **shout, sing, groan,**

or burst into fits of laughter. These symptoms of excitement apparently result from dreams which the patient seems to have. The effects of these dreams vary with the mode of life and the temperament of the individual. Religiously inclined persons may sing hymns or pray; others become abusive; they swear and fight. Some become jolly, they laugh and sing. Many become emotional, and some have fears of injury or death.

The pulse during this stage is rapid, the skin is flushed, often blue, the breathing is irregular because of the struggling. These symptoms last for a few minutes, the struggling then becomes lessened, the shouting and talking become indistinct, the breathing becomes very shallow and the patient passes into

The Third Stage, or the Stage of Anaesthesia

The patient now becomes calm, quiet and unconscious. All sensibility is gone. **The muscles are relaxed** and the reflexes disappear, so that when the skin is touched or incised, no response or movement is produced. Thus, touching the throat does not cause vomiting. The winking of the eyelids which occurs when the eye is touched, often remains for some time, however.

The pulse still remains rapid and strong, though it is slower than during the first and second stages. **The breathing is deep and rapid** and is often snoring in character. The pupil is usually contracted, and reacts to light and accommodation.

This stage of anaesthesia, may be kept up for hours, by judiciously pouring small quantities of ether on the mask.

When the ether is stopped, the patient may again become somewhat excited and talkative, he feels nauseated and vomits. He then slowly regains consciousness, often remaining asleep for a few hours before consciousness is regained, and complains of headache and dizziness for hours afterward.

ACTION

Local action: Applied to the skin, ether evaporates so rapidly, that it makes the skin feel cool. It also slightly numbs the sensation, acting as a mild local anaesthetic.

On mucous membranes: It causes redness and increases the secretion of mucus.

Internal Action

In the mouth: It has an unpleasant burning taste, and it increases the flow of saliva by the reflex action started by the redness of the mucous membrane which ether causes.

In the stomach: It increases the secretions of the mucous membrane, and slightly checks the formation of gas (carminative action) if given diluted.

In the intestines: Ether causes redness and swelling of the mucous membrane with profuse secretion of mucus. It relieves colic and is said to destroy intestinal worms (anthelmintic action).

Action after Absorption

Ether is absorbed into the blood in a few minutes, through the mucous membranes of the lungs, stomach or intestines. After absorption it affects principally the brain, the heart and the respiration.

Action on the brain: The effects of ether on the brain, are quite similar to those of alcohol. When given internally it has a tendency to soothe nervousness. It first lessens the higher intellectual, and then all the centers of the brain.

The uncontrolled talkativeness, the constant movements, the dreams occurring during the excitement stage, are all evidences of removal of restraint; from the speech, the motor and the imaginative centers of the brain. The loss of sensibility, the unconsciousness and the relaxations of all the muscles which follow the excitement stage, and which are present during the stage of anaesthesia, are the result of the diminished activity of the sensory and motor areas of the brain. The unconsciousness results because the appreciation of sensations is lessened.

Action on the spinal cord: The reflex action, which is the type of action prevalent in the spinal cord, is at first increased, but soon lessened, and then entirely abolished by ether. Many reflexes, however, such as the reaction of the pupil to light, the movements resulting when the sphincter is stretched, remain for a long time.

Action on the respiration: Ether makes the breathing faster and deeper. During the excitement stage of anaesthesia, however, the breathing may be irregular, because of the struggling and contractions of the muscles for breathing.

Action on the lungs: Ether increases the secretions of the mucous membranes of the bronchi and lungs.

Action on the circulation: Ether makes the heart beat stronger and faster. It contracts the blood vessels and increases the blood pressure. It dilates the blood vessels of the skin, however.

The characteristic pulse of ether is therefore rapid and strong. During the third stage of anaesthesia, the rate of the pulse is about normal, or a little above normal. As the anaesthesia progresses, however, the pulse gradually becomes weaker.

Action on the blood: Ether has a tendency to destroy red blood corpuscles.

Action on the muscles: When ether is given as an anaesthetic all the muscles are relaxed in the third stage.

Action on the pupils: During the first and second stages of anaesthesia, the pupils are dilated because of the excitement. During the third stage, the pupils are contracted, but they react to light.

Action on the kidneys: Ether is somewhat injurious to the kidneys. After a prolonged anaesthesia, it often causes albumin in the urine.

Excretion

Ether is very rapidly eliminated from the body, by the expired air of the lungs, usually in about a half hour. When given as an anaesthetic, it is entirely excreted in about 24 hours; the breath has its unpleasant odor during that time.

Idiosyncrasies

The most common variations in the effects of ether are the following:

1. In some individuals, and in children, there may be no excitement stage.
2. Patients who have been used to taking alcoholic liquors

regularly, require larger quantities of ether to produce anaesthesia. These patients usually struggle a great deal.

3. In some individuals, very small quantities may cause poisonous effects.

Poisonous Effects or " Ether Collapse "

Acute ether poisoning or ether collapse, usually results when too much ether is given to produce anaesthesia.

Symptoms

1. The first symptom which indicates that too much ether is being administered, is **slow, shallow and gasping breathing.**
2. The face then becomes blue and cyanotic and the breathing stops.
3. The pulse may not become affected, but it soon becomes weak and irregular.
4. The pupils are widely dilated, and do not react to light. The pulse gradually grows weaker, and death finally results from respiratory paralysis.

Treatment

1. Stop anaesthesia; take the mask away.
2. Give artificial respiration.
3. Elevate the foot of the table.
4. Stretch the sphincter of the rectum to induce breathing by the reflex action thus produced.
5. Give heart and respiratory stimulants such as caffeine, strychnine, atropine, etc.

Usually, if the collapse is recognized early, these measures will revive the patient.

Dangers of Ether Anaesthesia

The following symptoms occurring during anaesthesia often warn the anaesthetist of impending trouble.

1. Slow, shallow breathing.
2. Dilated pupils which do not react to light.
3. Slow, weak, irregular pulse.

4. Often the relaxed muscles of the tongue, cause the tongue to fall back and obstruct the breathing.

5. In some cases, continued vomiting of the contents of the stomach and intestines, during deep anaesthesia, may cause food particles to enter the lungs and cause asphyxia. This can be avoided by constantly keeping the mouth thoroughly mopped out.

Dangers Following Anaesthesia

The most common condition that may occur after ether anaesthesia is pneumonia. This may result from the injurious effect of ether on the lungs.

Preparations for Anaesthesia

Before administering ether, the following measures should always be carried out, but the nurse must receive these orders from the surgeon.

1. Move the bowels by a cathartic, about twelve hours before the operation, and give an enema the morning of the day the patient is to be operated upon.

2. Do not give any food or drink for about twelve hours before the operation. This often lessens the vomiting after the anaesthesia.

3. Catheterize the patient before the operation.

4. **Remove all false teeth,** so that the patient will not swallow them during the anaesthesia.

5. When the anaesthesia is begun, the eyes should be covered with a piece of gauze, and the face protected with vaseline to avoid the injurious effects of the ether fumes.

Administration

To produce anaesthesia, ether is given by inhalation through a mask held over the nose and mouth, in the following ways:

The Open Method or Drop Method

The ether is poured drop by drop on a mask covered with gauze, and the patient is then allowed to inhale the ether

vapor which is thoroughly mixed with air. This is the most common method of administration now in use.

The Closed Mask Method

This method is gradually being abandoned. The ether is given through a cone saturated with ether, which is thus mixed with very little air.

Gas Ether Method

This is a very common method now in vogue, whereby the patient is first given nitrous oxide gas, and then ether. In this way, many of the unpleasant effects of ether, and the excitement stage, are avoided.

There are numerous kinds of apparatus for giving ether by this method, many of which have various advantages, such as warming the vapor, etc.

Other Methods of Anaesthesia

Ether is also occasionally given as an anaesthetic by the rectum, by means of a specially constructed apparatus.

Recently, a method has been devised for producing anaesthesia by giving ether intravenously. The ether is given in an infusion of salt solution.

In giving an anaesthetic, it is important that the drug be administered very slowly. The breathing and pulse should be watched very carefully throughout the anaesthesia, so as to avoid serious dangers.

Uses

Besides its use as an anaesthetic, ether is used for the following effects:

1. As a heart stimulant.
2. To check convulsions.
3. As a carminative, to lessen the formation of gas in the stomach and intestines.

Preparations

Ether	0.5–1.0 c.c.	m. viii–xv

(**Aether**) This contains 96% of ether, and is used principally as an anaesthetic. The dose of ether for anaesthesia varies with the patient, and the degree of anaesthesia desired.

Spirits of Ether (**Spiritus Aetheris**)	2.0–4.0 c.c.	$3\frac{1}{2}$–i

This consists of 32 parts of ether and 68 parts of alcohol.

Compound Spirits of Ether (Spiritus Aetheris Compositus) (Hoffman's Anodyne)	2.0–4.0 c.c.	3½–1

This contains 32% of ether, alcohol and other substances known as ethereal oils. It is used principally to check the formation of gas in the stomach and intestines, and as a remedy for fainting. It is usually diluted with cold or iced water.

Spirit of Nitrous Ether (Spiritus Aetheris Nitrosi) (Sweet Spirit of Niter)	1.0–4.0 c.c.	m. xv–3i

This preparation is used to increase the perspiration and the flow of urine, but it also causes the same stimulating effects as ether.

CHLOROFORM

Chloroform is a colorless non-inflammable fluid, which evaporates easily, but not as rapidly as ether. It is formed by the combination of alcohol with chlorine. Chemically, it is a compound of methane (marsh gas) with chlorine forming trichlor methane or chloroform. It is used principally as an anaesthetic.

Chloroform Anaesthesia

When chloroform is given as an anaesthetic, the symptoms it produces can be divided into three stages as in ether anaesthesia.

During the first stage, the patient is nervous, anxious, and his sensations are dulled, but the anaesthetic is more pleasant to take than ether. The pulse is usually rapid.

Very soon, the second stage sets in, the excitement, talkativeness and struggling, however, are usually much less, and last for a shorter time than with ether. **This stage is very often entirely absent.**

The stage of anaesthesia, or third stage, comes on very rapidly with chloroform. The patient is calm, quiet and unconscious. **The breathing is slow and shallow, the rate of**

the pulse is normal, perhaps somewhat slower but weak. The face is pale, and the pupils are contracted, but they react to light. All sensibility and reflex action are gone, and the muscles are relaxed.

With chloroform, anaesthesia is induced more rapidly than with ether, usually in about five or ten minutes. The muscles become relaxed sooner, the pulse is weak and slower and the breathing is shallow.

ACTION

Local action: Applied to the skin, the sensibility is somewhat lessened by chloroform, and it causes redness and a burning sensation. If it is prevented from evaporating, it may form a blister. **On mucous membranes:** It causes redness and increases the secretion.

Internal Action

In the mouth: It has a hot sweetish taste and it increases the flow of saliva.

In the stomach: It causes a feeling of warmth and checks the formation of gas (carminative action). It increases the secretion and the peristalsis. It is usually absorbed from the stomach and does not enter the intestines.

Action after Absorption

Chloroform is absorbed into the blood through the mucous membrane of the stomach in about fifteen minutes, when given by mouth. When inhaled as an anaesthetic, it enters the blood from the mucous membrane of the lungs still more rapidly. It is also readily absorbed through all the mucous membranes. After absorption it affects principally the brain, the heart and the respiration.

Action on the brain: Chloroform produces the same effects on the brain as ether does. It causes progressive depression of the brain centers beginning with the higher intellectual centers, followed by rapid depression of the other centers as well. The result of this action, is a preliminary stage of excitement and talkativeness, followed

by unconsciousness, loss of sensation and relaxation of the muscles.

Action on the spinal cord: Chloroform at first increases, and then lessens the reflex action throughout the body.

Action on the respiration: It makes the breathing slower and shallower.

Action on the lungs: Chloroform does not increase the secretion of the lungs as much as ether does.

Action on the circulation: Chloroform makes the heart beat slower and weaker, by weakening the contractions of the heart muscle. It widens the blood vessels and lowers the blood pressure. **The chloroform pulse is slow and weak.**

Action on the blood: Chloroform has a tendency to destroy red blood corpuscles.

Action on the pupil: The pupil is contracted, but it reacts to light and accommodation.

Action on the muscles: Chloroform relaxes all the muscles of the body.

Action on the kidney: It is distinctly injurious to the kidney, and changes some of the constituents of the kidney cells to fat. It often causes albumin in the urine.

Excretion

Chloroform is rapidly eliminated, mainly by the expired air of the lungs; though some of it is also excreted by the urine and the perspiration.

Poisonous Effects

Chloroform poisoning occurs in two forms:

1. **Acute Chloroform Poisoning**
2. **Delayed Chloroform Poisoning**

Acute Chloroform Poisoning

Acute chloroform poisoning usually results when too much chloroform is given as an anaesthetic; or in susceptible individuals, from very small quantities; even from a few drops.

Sudden Chloroform Death

Sudden death occasionally occurs from chloroform, in susceptible individuals, even when only a few drops are administered for anaesthesia.

This usually occurs during the first stage of anaesthesia. **The pulse becomes very slow and weak, the face turns pale, the breathing becomes very shallow and slow, the pupils are widely dilated, and the patient dies in a few minutes.**

This very unfortunate occurrence is the result of the coughing and burning pains in the throat which occur during the first stage of anaesthesia. Impulses are thus sent to the Vagus center in the medulla, which then sends impulses to the heart to make it beat slower. (Reflex action.)

Such impulses usually cause fainting, which is a condition in which the heart stops beating for a few moments, but soon recovers again. In sudden chloroform death, however, the heart muscle is poisoned by the chloroform; so that after it has suddenly stopped beating, it does not contract again, and death results.

If atropine is given before chloroform anaesthesia, it occasionally acts as a safeguard against this dreaded accident. The atropine paralyzes the nerve endings of the Vagus nerve in the heart, and prevents impulses to slow the heart contractions, from reaching it.

When sudden chloroform collapse occurs, it is usually treated by giving atropine and other heart stimulants hypodermically, and massaging the chest over the heart. Every now and then patients recover after vigorous treatment.

Symptoms of Chloroform Collapse

When too much chloroform is given during anaesthesia, the following symptoms usually result, in the order of their onset.

1. The pulse becomes slow, weak and irregular, usually about 50 or 40 to the minute.
2. Slow and shallow breathing.
3. Pallor of the skin.
4. The pupils are widely dilated, and do not react to light or accommodation.

5. The pulse and breathing become still slower, and the patient dies from paralysis of the heart.

Treatment

1. Stop the anaesthesia, and take the mask away as soon as the slow and weak character of the pulse is noticed.
2. Stimulants such as atropine, caffeine, strychnine, etc., are usually given.
3. Give artificial respiration.
4. Elevate the foot of the table.

Delayed Chloroform Poisoning

This form of chloroform poisoning occurs occasionally. The symptoms appear about a few days after the anaesthetic has been administered. It is due to the destruction of many of the cells of the liver, kidneys, and heart, which then become filled up with fat globules (fatty degeneration).

Symptoms

1. Nausea and vomiting; the vomited matter containing bile.
2. Jaundice.
3. Delirium.
4. Convulsions.
5. Scanty urine, which contains albumin, and two substances characteristic of this condition, **leucin** and **tyrosin**.
6. Collapse (slow, weak pulse, slow, shallow breathing, etc.).

The patient usually dies in a few days from profound collapse.

Administration

Chloroform is usually given by inhalation, by means of a mask covered with gauze, which is held over the patient's nose and mouth. A few drops of chloroform are poured on the mask and allowed to mix thoroughly with air. Dangers of chloroform are best avoided by pouring the chloroform very slowly, a drop at a time, and allowing the vapor to thoroughly mix with air.

The nurse is often called upon to give chloroform during labor, in obstetrical cases. Very little chloroform should then be given, as in such cases it is only necessary to administer the chloroform when the patient has severe pains. Complete anaesthesia is not desired in these cases, as the uterine contractions are then lessened, and the birth of the child is thus retarded. The pulse and breathing should be watched very carefully throughout the anaesthesia.

Uses

Beside its use as an anaesthetic, chloroform is given:

1. To stop convulsions (by inhalation).
2. To check diarrhoea and to lessen colic (by internal administration).
3. Chloroform liniment is frequently used as a local application to relieve pain.

Preparations

For Internal Use:

Chloroform (Chloroformum)	0.06–1.0 c.c.	m. i–xv

The dose of chloroform for anaesthesia, varies with the patient, and the degree of anaesthesia desired.

Chloroform should always be kept in brown bottles, as it is readily decomposed into dangerous substances, by the action of light.

Spirits of Chloroform (Spiritus Chloroformi)	2.0–4.0 c.c.	m. xxx–ʒ i

This contains 10% of chloroform.

Emulsion of Chloroform (Emulsum Chloroformi)	15.0–30.0 c.c.	ʒ ½–i

This contains 4% of chloroform.

Chlorodyne (Not official)	0.3–2.0 c.c.	m. v–xxx

This contains chloroform, ether, hydrocyanic acid, morphine and cannabis indica.

For Local Use:
Chloroform Liniment
(Linimentum Chloroformi)

This consists of soap liniment and chloroform, and contains 30% of chloroform.

Compound Chloroform Liniment (not official)
(Linimentum Chloroformi Compositus)

This contains chloroform, oil of turpentine, laudanum, tincture of aconite, and soap liniment.

COMPARATIVE ACTION OF ETHER AND CHLOROFORM

ETHER	CHLOROFORM
1. Inflammable	1. Not inflammable
2. Cools the skin	2. Burns the skin
3. Unpleasant to take	3. More pleasant to take
4. Anaesthesia induced with larger quantities, and not as deep.	4. Deeper anaesthesia induced with smaller quantities.
5. Marked excitement stage	5. Little or no excitement stage
6. Pulse rapid and strong	6. Pulse slow and weak
7. Skin bright red in color	7. Skin pale
8. Suitable in cases where the heart action is weak or where the kidneys are diseased.	8. Suitable in cases where the lungs are diseased or in drunkards.
Dangers	
9. Respiratory collapse	9. Cardiac collapse
After Effects	
10. More vomiting	10. Less vomiting
11. Apt to cause pneumonia	11. Apt to cause delayed chloroform poisoning

ETHYL BROMIDE (AETHYLIC BROMIDUM) (not official)

Ethyl bromide or bromide of ether, is a colorless liquid which evaporates easily. It has a disagreeable, sweetish taste, and an ethereal odor.

ACTION

Ethyl bromide is used to produce anaesthesia, especially for short operations, or to begin an ether anaesthesia. Its effects are similar to those of chloroform, and it has the same weakening action on the heart. When its administration is stopped, consciousness returns very quickly, and the patient feels quite weak. It is usually given as a concentrated vapor, mixed with very little air.

It should be kept in brown bottles, as it is decomposed very easily by the action of light, forming dangerous substances.

ETHYL CHLORIDE (AETHYLIC CHLORIDUM)

Ethyl chloride, chloride of ether or kelene, is formed by the action of hydrochloric acid gas on alcohol. It evaporates very easily. It usually comes in special glass containers, with a long, pointed tip, which is broken off or unscrewed. A fine stream of vapor then shoots out, which is directed on the mask; or, for local anaesthesia, on the skin.

ACTION

Local action: Because it evaporates very easily, ethyl chloride freezes the skin over which it is applied, producing local anaesthesia of the part. Minor surgical operations can be performed under such local anaesthesia. It should be applied until the tissues become white and hard, then stopped; if it is continued after this effect is obtained it is apt to injure the tissues.

General Action

Ethyl chloride is also used as a general anaesthetic. It produces anaesthesia very rapidly, usually in about 1 to 5 minutes.

Its effects are similar to those of chloroform, but it does not cause complete muscular relaxation. **The pulse is slow and weak,** and the breathing is deep. The patient usually recovers from the effects very rapidly. It is usually given to start an ether anaesthesia. It is not suitable for prolonged use, because it weakens the heart even more than chloroform and it does not cause complete muscular relaxation.

PENTAL

Pental is a colorless liquid made from fusel oil. Chemically it is trimethylethylene.

It has been used to produce anaesthesia for short operations, and it produces no after effects. Its effects are similar to those of ether or chloroform, but it does not cause much muscular relaxation. It has no effect on the heart or respiration. It occasionally causes twitchings of the muscles, or convulsions, even during anaesthesia.

METHYLENE BICHLORIDE (not official)

Methylene bichloride is an inflammable, colorless fluid which has an odor like chloroform. Its effects are similar to those of chloroform. It produces rapid anaesthesia which soon wears off. It slows and weakens the heart action.

ANAESTHETIC MIXTURES

The following preparations are mixtures of various anaesthetics. They are said to have various advantages over a single anaesthetic.

A. C. E. MIXTURE

This consists of

Alcohol	1	
Ether	2	Parts by volume
Chloroform	3	

ANAESTHOL

This is a mixture of

Chloroform	36%
Ether	47%
Ethyl Chloride	17%

This mixture is said to have the same boiling point as the blood, and therefore to be easily excreted. The dangers of chloroform are thus said to be avoided.

When these mixtures are given, the ether and the ethyl chloride evaporate more quickly than the chloroform.

The anaesthetist is then giving concentrated chloroform, instead of a diluted mixture. Dangerous symptoms are thus more apt to follow, especially in warm weather, since the ether and other ingredients evaporate more easily than the chloroform.

SOMNOFORM

This is a mixture of

Ethyl Chloride 65%
Ethyl Bromide 5%
Methyl Chloride 30%

NITROUS OXIDE GAS (LAUGHING GAS)

Nitrous oxide gas is a colorless gas without any odor. It is made by distilling ammonium nitrate. The gas is passed through water, and collected in small metal cylinders, in which it usually comes for practical use. It is the safest and most pleasant anaesthetic known.

Appearance of the Patient
Nitrous Oxide Anaesthesia

A few seconds after inhaling nitrous oxide gas, the patient usually feels **rushing, drumming or hammering noises in the ears,** the sight becomes indistinct, and he has a feeling of warmth and comfort all over the body. **The arms and legs move constantly about,** the patient is **bright, lively, very jolly, and bursts out into fits of laughter** (hence the name "laughing gas"). These symptoms last for about 2 or 3 minutes and then the patient feels drowsy, falls asleep, and loses all sensibility.

During the anaesthesia, the **face is dark red in color, often blue, the breathing is deep and snoring in character,** the pulse is slow, strong and tense, and **the blood pressure is very high.** If the nitrous oxide is judiciously mixed with air, the anaesthesia can be kept up for a half to one hour.

As soon as the mask is taken away, however, the patient becomes conscious in about 1 to 3 minutes, and has no after effects, except perhaps a slight headache, which may persist for a few hours.

Nitrous oxide does not relax the muscles, so that prolonged abdominal operations cannot be performed under its anaesthesia.

ACTION

Nitrous oxide is a gas which is only given by inhalation to produce anaesthesia. It is absorbed into the blood from the lungs almost immediately. The symptoms which it produces are due to its action on the brain, the blood and respiration.

Action on the brain: The noises in the ears, the movements of the extremities, the laughter, are all evidences of increased activity of the brain. These symptoms last for a few minutes and are almost immediately followed by symptoms of lessened brain activity; such as sleep and loss of sensation.

Action on the respiration: Nitrous oxide gas, by taking the place of oxygen in the lungs and in the blood, prevents the haemoglobin from obtaining its necessary oxygen. The patient then suffers from asphyxia. This makes **the breathing deep and snoring in character** (stertorous), **and the blood becomes blue in color** so that the face has a purple or blue color during anaesthesia.

Action on the heart: The slow, strong pulse and high blood pressure are the result of the asphyxia, and are not due to any effect on the heart or blood vessels.

Excretion

Nitrous oxide gas is eliminated from the body in a few minutes by the expired air.

Poisonous Effects

When too much nitrous oxide is given, the following symptoms are produced, because the haemoglobin is unable to obtain its necessary oxygen. The blood is then impure and is poisonous to the brain and other organs of the body.

Symptoms

1. The face is blue in color.

2. The breathing is difficult and deep.
3. Slow, strong pulse, with very high blood pressure.
4. Convulsions.

These symptoms disappear as soon as the nitrous oxide is stopped.

Administration

Nitrous oxide gas is usually given by inhalation, by means of a specially constructed apparatus, consisting of a mask attached to a large rubber bag, which is filled with the gas from a metal container.

Uses

Nitrous oxide gas is used to produce anaesthesia for short surgical operations, and to begin ether anaesthesia, so as to avoid its unpleasant symptoms and excitement stage.

It is frequently given together with oxygen for a prolonged anaesthesia.

CHAPTER XIX

HYPNOTICS

Hypnotics, soporifics, narcotics, or somnifacients, are drugs which lessen the activity of the brain, and produce sleep, or unconsciousness.

Their effects are similar to those of the general anaesthetics, but they are milder, more lasting, and do not relieve pain.

The hypnotics are usually given by the mouth and are slowly absorbed; their effects lasting for several hours.

Mode of Action

Our consciousness depends upon the impulses received from our surroundings through the various senses. Hypnotics, by lessening the activity of the brain, also lessen the activity of its sensory areas, so that fewer impulses are received from our environments, and unconsciousness or sleep results.

When the activity of the sensory areas is lessened, the appreciation of pain, one of the sensations, is also lessened; so that many of the hypnotics relieve pain (analgesic action) besides producing sleep.

The most efficient hypnotic is chloral.

MORPHINE AND OPIUM

Morphine and opium produce sleep when the patient is unable to sleep on account of pain. Their effects have been more fully described under their more important actions. (See page 299.)

BROMIDES

Bromides produce sleep when the patient is unable to sleep on account of nervousness.

CHLORAL

Chloral is an oily, colorless liquid made by the combination of chlorine gas with absolute alcohol. It is not used in

medicine, but when it is combined with water, it forms crystals of **chloral hydrate**, which is the preparation ordinarily used.

Appearance of the Patient

About 5 to 15 minutes after an average dose of chloral hydrate is given, the patient feels tired and drowsy, and soon falls asleep. The sleep lasts for about five to eight hours. It resembles the natural sleep, and the patient can be easily awakened; by pain, loud sounds, or when touched. During the sleep, the pulse and breathing are slow, and the pupils are contracted.

When the patient awakes, he may complain of a little headache and dizziness, and may be somewhat confused.

ACTION

Local action: Applied to the skin, chloral causes redness and even blisters. It also acts as an antiseptic, checking the growth of bacteria. On mucous membranes it causes redness and increases the secretions.

Internal Action

In the mouth it has a hot, burning taste.

In the stomach and intestines: It increases the secretions. It occasionally causes nausea and vomiting.

Action after Absorption

Chloral is very rapidly absorbed into the blood through the mucous membrane of the stomach and intestines; usually in about 5 to 15 minutes. After absorption, it affects principally the brain, the heart, and respiration.

Action on the brain: Chloral lessens the activity of the brain. The sensory areas are particularly affected; so that the brain does not appreciate the impulses received through the various senses, and unconsciousness or sleep then results. Very intense sensations, such as pain, are appreciated, however; and these may even prevent sleep. Chloral also lessens the motor activities of the brain.

Action on the spinal cord: The reflex actions of the spinal cord are lessened by chloral. External stimuli applied to various parts of the body therefore produce a slow response.

Action on the heart: Chloral makes the heart beat slower and weaker by weakening the contractions of the heart muscle. **The pulse then becomes slower and weaker.**

Action on the respiration: The breathing becomes somewhat slower and shallower, because fewer impulses for breathing are sent out from the respiratory center in the medulla.

Effect on the temperature: Chloral lowers the temperature several degrees by lessening the muscular movements, so that less heat is produced.

Excretion

Chloral is eliminated from the body mainly by the kidneys in several hours, as urochloralic acid.

Idiosyncrasies

Chloral often causes the following unusual effects:

1. Redness and swelling of the conjunctiva of the eye.
2. Flushed face and neck.
3. Eruptions: large, red areas on the skin, which are often distinctly raised above the surface (wheals). The eruptions often peel (desquamate).
4. Dyspnoea.
5. Rise of temperature.

Dangerous Symptoms

Chloral Collapse

In giving chloral, the patient must be carefully watched, and the pulse should be taken very frequently; as sudden heart failure from chloral is not at all uncommon, even from a single dose.

Symptoms

1. Restlessness.
2. Slow, weak pulse.
3. Slow, shallow breathing.
4. Coma.

The chloral should be stopped when these symptoms appear.

The danger is usually over when the pulse is above 60 and is regular and strong.

Tolerance

If chloral is taken habitually, the patient becomes accustomed to the drug, so that large doses may be taken without producing any poisonous effects.

Poisonous Effects

Acute chloral poisoning is a condition which may result when an overdose of chloral is given medicinally, or from the malicious administration of an overdose of chloral in alcohol ("knockout drops").

Symptoms

1. Very deep sleep from which the patient is aroused with difficulty. (Stupor.)
2. Very slow and shallow breathing.
3. Slow, weak, irregular pulse with low blood pressure.
4. Insensibility to pain.
5. Contracted pupils.
6. Relaxation of the muscles.
7. Coma (deep sleep from which the patient cannot be awakened).
8. Collapse.

Death usually results from paralysis of the heart and breathing. The smallest fatal dose is 2.0 gms. (grs. xxx).

Treatment

1. Wash out the stomach.
2. Give artificial respiration.
3. Keep the patient warm and quiet. Excitement may be fatal.
4. Atropine, caffeine, strong coffee, or alcohol are usually given to increase the action of the heart and respiration.

Chloral Habit

Habitual use of chloral often causes symptoms resembling those of chronic alcoholism. Many of the constituents of the cells of the various organs of the body, such as the liver and kidney are changed to fat globules. The following symptoms usually result from this condition:

1. The patient feels melancholic and "blue."
2. Wakefulness and nervousness at night.
3. Loss of appetite and disturbed digestion.
4. Various eruptions on the body.

If the drug is suddenly stopped, symptoms resembling delirium tremens result. To relieve these symptoms, the patient must be gradually weaned of the habit.

Uses

Chloral is used principally:

1. To produce sleep.
2. To lessen the excitement of delirium tremens and other similar conditions.
3. To prevent the convulsions of strychnine poisoning, epilepsy, uraemia, etc.

Administration

Chloral hydrate is best given only slightly diluted in syrup, about 15 minutes to a half hour before bedtime.

Preparations

Chloral Hydrate (Chloralum Hydratum)	0.6–2.0 gms.	grs. x–xxx
Croton Chloral Hydrate or **Butyl Chloral Hydrate**	0.3–1.3 gm.	grs. v–xx

This resembles chloral in its effects; it is not as efficient but the effects are more lasting. It particularly lessens the sensations carried from the face by branches of the fifth cranial nerve. It is therefore frequently used to relieve the intense pain of trifacial neuralgia ("tic douleureux").

Metachloral (not official)

This is a substance made by the action of sulphuric acid on chloral. It is used as a local anaesthetic.

Bromal Hydrate (not official) 0.12–0.3 gm. grs. ii–v

This substance is formed by the action of bromine on alcohol. It acts like chloral, but is more dangerous.

Chloral Camphor: This consists of equal parts of chloral and camphor and is used as a local application to relieve pain.

CHLORALFORMAMID

Chloralformamid is a white, crystalline powder with a slightly bitter taste. It is a chemical compound of chloral.

It produces sleep; its effects are similar to those of chloral. It does not weaken the heart action, but it is not as reliable as chloral.

Preparations

Chloralformamid 1.0–2.0 gms. grs. xv–xxx

It is usually given in powder form, dissolved in whiskey.

CHLORETONE

Chloretone is a white, crystalline powder which does not readily dissolve in water. It has an odor like camphor.

ACTION

Local action: Applied to the skin, it acts as an antiseptic.

Internal Action

When it is taken internally, it soothes the stomach, and is rapidly absorbed into the blood. After absorption, it acts principally on the brain. It lessens the activity of the brain, producing sleep. By lessening the motor activities of the brain, so that fewer impulses for motion are sent out from the brain, it lessens muscular contractions. Chloretone can produce general anaesthesia, but it is rarely used for this effect.

Uses

Chloretone is used to produce sleep, very frequently to check an epileptic attack; and to lessen other convulsions, such as those occurring in tetanus, etc. It is occasionally used to check vomiting and seasickness.

Preparations

Chloretone	0.3–1.0 gm.	grs. v–xv

It is also used in a 1% solution.

CHLORALOSE (not official)

Chloralose is a white, crystalline powder, having a bitter taste. It is a compound of chloral and glucose (grape-sugar).

It produces sleep; its effects are similar to those of chloral, but it is not as reliable.

Preparations

Chloralose	0.3–0.6 gm.	grs. v–x

SULPHONAL

Sulphonal or sulphonmethanum, is a white powder without any odor or taste. It does not dissolve readily in water. Chemically, it is a compound of sulphur and alcohol.

Appearance of the Patient

Within 1 to 6 hours after giving a dose of sulphonal, the patient falls asleep. The sleep is not very deep, but it lasts for about 8 to 10 hours, and sometimes longer. The pulse and breathing are usually not affected. On awakening, the patient often feels drowsy, complains of fullness in the head, and headache; and his gait may be a little unsteady. Occasionally, sulphonal is so slowly absorbed that it produces sleep the day following the night of its administration.

ACTION

Sulphonal resembles chloral in its effects, which appear more slowly, however. It produces no local effects.

Internal Action

No effects are produced by sulphonal in the mouth, stomach, or intestines.

Action after Absorption

Sulphonal is very slowly absorbed into the blood from the stomach, usually in about 1 to 6 hours. After absorption, it affects principally the brain.

Action on the brain: It lessens the activity of the brain, producing sleep.

Action on the respiration: In large doses, sulphonal often makes the breathing slow and shallow.

It does not affect the heart action.

Excretion

Sulphonal is eliminated very slowly by the urine, as ethylsulphonic acid. Since it is excreted more slowly than it is absorbed, it often causes cumulative symptoms.

Idiosyncrasies

In some individuals, instead of sleep, the following symptoms are produced:

1. Nausea and vomiting.
2. Excitement.
3. Dizziness.
4. Staggering.

Poisonous Effects

Acute Sulphonal Poisoning

An overdose of sulphonal is rarely, if ever, fatal. It occasionally causes the following symptoms:

1. Stupor.
2. Slow, shallow breathing.

Cumulative Sulphonal Poisoning

Since sulphonal is more slowly excreted than it is absorbed, its prolonged use often causes the following alarming symptoms, which may even result in death:

1. Pink color of the urine, due to haematoporphyrin, a substance which is formed in the urine by the decomposition of the haemoglobin of the blood.
2. Abdominal pain.
3. Nausea and vomiting.
4. Constipation.
5. Weakness and unsteady gait.
6. Mental confusion and hallucinations.
7. Paralysis of various groups of muscles of the arms or legs.
8. Suppressed urine; the urine often containing albumin.
9. Collapse, which may result in death.

Treatment

1. Stop the drug.
2. Saline diuretics are usually given.
3. Move the bowels thoroughly.
4. The collapse is usually treated with heart stimulants.

Administration

Sulphonal is best given in large quantities of milk or hot water several hours before bedtime. When given in this way, it acts more readily and is not so apt to cause unpleasant after effects. It may also be given in the form of a powder.

Preparations

Sulphonal (Sulphonmethanum)	1.0–2.0 gm.	grs. xv–xxx

VERONAL or BARBITAL

Veronal, barbital, or diethyl barbituric acid, is a white crystalline powder, which has a slightly bitter taste. It is an artificial chemical substance.

Appearance of the Patient

About fifteen minutes to half an hour after an average dose of veronal is given, the patient usually falls asleep. The sleep resembles the normal sleep, and lasts for five to

six hours. On awakening, the patient often complains of headache and dizziness. Occasionally, some patients have peculiar vivid dreams during the sleep. The pulse and breathing are not usually affected by veronal. It is a comparatively safe drug in small doses; but poisonous symptoms (coma, slow pulse and shallow breathing) have occasionally followed its indiscriminate use, especially in old people.

Administration

Veronal is usually given in hot milk, about fifteen minutes to a half an hour before bedtime.

Preparations

Veronal or Barbital (Veronalum) Diethyl Barbituric Acid	0.3–1.0 gm.	grs. v–xv

It usually comes in tablets each containing 0.3 gm. (grs. v) each.

Veronal Sodium (Medinal) (Sodium Diethyl Barbiturate)	0.3 gm.	grs. v

This is a sodium salt of veronal. It usually comes in tablets each containing 0.3 gm. (grs. v). It produces the same effects as veronal, but since it is more readily dissolved, it produces sleep more rapidly, and it can be given hypodermically or by rectum.

Medinal Suppositories

Each suppository contains 0.5 gm. (grs. vii$\frac{1}{2}$).

TRIONAL

Trional, or sulphonethylmethanum, is a powder having a bitter taste. It is an artificial chemical substance.

Appearance of the Patient

An average dose of trional usually produces natural sleep in about 15 minutes to an hour after it is given. The sleep lasts several hours and is accompanied by slight headache.

ACTION

The effects of trional are the same as those of sulphonal. It is more readily absorbed, however, and it does not affect the heart or respiration as much. It occasionally causes the same cumulative poisonous symptoms as sulphonal.

Administration

Trional should be given about a half to one hour before bedtime in large quantities of hot milk or beer.

Preparations

Trional (Sulphonethylmethanum)	1.0–2.0 gms.	grs. xv–xxx

TETRONAL (not official)

Tetronal is a white powder. Its effects are similar to those of trional and sulphonal. It is given in the same way, but it is not often used because it is more poisonous.

Tetronal	1.0–2.0 gms.	grs. xv–xxx

BROMURAL

This is an organic bromide salt (monobrom-isovaleryl urea). It is used to produce sleep in nervous patients. The sleep usually lasts for three to five hours. It usually comes in tablets, each containing 0.3 gm. (grs. v) each.

PARALDEHYDE

Paraldehyde is a colorless liquid having a peculiar, unpleasant taste and odor. It is an oxidation product of alcohol.

Appearance of the Patient

A few minutes after an average dose of paraldehyde is given, the patient becomes drowsy and soon falls asleep. The sleep resembles the natural sleep, and lasts from about 5 to 6 hours, but it is not as deep as that of chloral. The

pulse and breathing are normal, and there are usually no after effects when the patient awakes.

ACTION

The action of paraldehyde is similar to that of chloral.

Local action: Applied to the skin, it causes redness, pain, and occasionally forms blisters. **On mucous membranes:** It causes redness and increases the secretions.

Internal Action

In the mouth: Paraldehyde has a hot, burning taste.

In the stomach and intestines: It increases the secretions; it often causes nausea and occasionally vomiting.

Action after Absorption

Paraldehyde is absorbed into the blood in a few minutes; through the mucous membrane of the stomach. After absorption, it acts principally on the nervous system.

Action on the brain: Paraldehyde lessens all the activities of the brain, thereby **producing sleep.** Intense sensations, such as pain, can still be appreciated, however, and these may keep the patient awake.

The motor activities of the brain are also lessened, and the muscles are relaxed during sleep.

Action on the spinal cord: Paraldehyde lessens all the activities of the spinal cord. All reflex action is lessened, so that the patient does not respond readily to external stimuli.

Action on the heart and respiration: Paraldehyde does not affect the heart action, and in the doses that it is usually given, it does not affect the breathing.

Effect on the temperature: Paraldehyde lowers the temperature by lessening the production of heat.

Excretion

Paraldehyde is excreted in the urine in a few hours. It is also eliminated by the expired air of the lungs. The breath often has the unpleasant odor of paraldehyde for a long time after it is given.

Poisonous Effects

Paraldehyde rarely, if ever, causes fatal symptoms. Overdoses often cause the following symptoms:

1. Vomiting.
2. Stupor.
3. Slow, shallow breathing.
4. Cyanosis.

Prolonged use occasionally causes the following symptoms:

1. Nausea, loss of appetite, and poor digestion.
2. Ulcers in the nose.
3. Various eruptions, principally areas of redness. (Erythema.)

Uses

Paraldehyde is used principally to produce sleep and to lessen muscular activity in epilepsy and delirium tremens.

Administration

In giving paraldehyde, it is important to disguise its taste, otherwise many patients cannot take it. It should be well diluted in water, brandy, syrup, or sweetened butter. It should be given a few minutes before bedtime.

Paraldehyde is frequently given by the rectum especially in cases of delirium tremens. The best method is to dissolve the drug in boiled starch and then inject it into the rectum through a catheter.

Preparations

Paraldehyde (Paraldehydum)	1.0–4.0 gms.	grs. xv–℥i

URETHANE (ETHYL CARBAMATE)

Urethane or ethyl carbamate is a colorless, crystalline powder with a salty taste. It is an artificial chemical substance.

ACTION

Urethane produces sleep in about 15 to 20 minutes, the sleep lasting for about 6 to 8 hours.

Its effects are similar to those of paraldehyde, but it is not as reliable. It also increases the secretion of urine.

It does not upset the stomach, however, and because it is readily dissolved, it may be given hypodermically.

Preparations

Urethane (Aethylis Carbamas)	1.0–4.0 gms.	grs. xv–℥i

BROMOFORM

Bromoform is a heavy colorless liquid with an odor and taste like that of chloroform.

ACTION

Bromoform acts like chloral, but its following principal effects appear more slowly:

1. It produces sleep.
2. It relieves pain.
3. It lessens spasmodic contractions of the muscles.
4. It is an antiseptic.

It is principally used to relieve the spasmodic cough of whooping cough.

Bromoform	0.2 c.c.	m. iii

AMYLENE HYDRATE (not official)

Amylene hydrate is a colorless liquid, having an odor resembling that of camphor, and a pungent taste.

ACTION

It produces sleep; its effects are similar to those of chloral, but they are not as marked. It weakens the contractions of the heart and lessens all muscular contractions.

It is best given in capsules or in water, flavored with licorice.

Preparations

Amylene Hydrate (Amyleni Hydras)	2.0–4.0 c.c.	m. xxx–℥i

HYPNONE (not official)

Hypnone is a colorless liquid formed from alcohol. It has a characteristic odor like that of oranges. It produces sleep but it is not very efficient.

Hypnone	0.3–0.6 c.c.	m. v–xv

NEW AND NON-OFFICIAL HYPNOTICS

HEDONAL

Hedonal is a white crystalline powder with a cooling effect in the mouth, like that of menthol.

It produces sleep in about half an hour after it is given. It is a comparatively safe drug and produces no after effects. It occasionally increases the flow of urine.

Preparations

Hedonal	2.0 gms.	grs. xxx

It is given in powders or tablets.

ISOPRAL

Isopral is a white crystalline substance, with an aromatic taste and an odor resembling camphor.

It produces sleep in about five minutes after it is given. Its effects are similar to those of chloral, but it is not as poisonous. It is said to be absorbed through the skin.

Preparations

Isopral	0.2–0.5 gm.	grs. iii–viii

NEURONAL

Neuronal is a white crystalline substance having a bitter taste and odor resembling menthol. It produces sleep. Its effects resemble those of veronal, and it is given in the same way.

Neuronal	0.3–2.0 gms.	grs. v–xxx

DORMIOL (AMYLENE CHLORAL)

Dormiol or amylene chloral, is a colorless oily fluid with an odor like that of camphor. It is a compound of amylene hydrate and chloral. It produces sleep in about half an hour after it is given, with no after effects and it does not weaken the heart action. It is given principally to insane patients.

Preparations

Amylene Chloral	1.0–4.0 c.c.	m. xv–℥i

Other Hypnotics

Acetal	4.0–8.0 gm.	℥i–ii

Methylal

These are chemical substances formed from alcohol, which are occasionally used to soothe the patient and to produce sleep. They act like sulphonal.

Pellotine Hydrochloride	0.015–0.6 gm.	grs. $\frac{1}{4}$–i

This is an alkaloid from a Mexican plant used to produce sleep.

CHAPTER XX

ANTIPYRETICS

Antipyretics are drugs which are used principally to lower the body temperature.

Heat Production and Elimination

The heat of the body is produced by the activity of the cells of the various organs of the body and by the contractions of the muscles.

When too much heat is produced, the excessive heat is eliminated in the following ways:

1. **By evaporation from the skin.** The widened blood vessels of the skin contain more overheated blood, and the excessive heat evaporates from the skin.

2. **By increased perspiration.** The perspiration is overheated, and evaporation of the profuse perspiration eliminates some of the heat.

3. **By the exhaled air.** The expired air contains more heat; which is then eliminated.

Heat Regulation

The heat of the body is kept at a constant temperature, usually about 98.6 Fahrenheit, by means of a regulating center of gray matter in the brain (situated in the region of the corpora quadrigemina). This is called the heat regulating center. This center keeps the body temperature always at 98.6 F. in the following ways:

1. **When the temperature is below 98.6 F.,** it is brought up to normal again by increased production of heat. This is done by means of increased muscular activity and greater activity of the various organs of the body. For example, after a convulsion or a chill, which is a series of muscular contractions, the temperature usually rises several degrees.

2. **When the temperature is above 98.6 F.,** the temperature is lowered to normal again, by the increased elimination of heat. This is the result of increased sweating, dilatation

of the blood vessels of the skin and deeper and more rapid breathing. For example, when the weather is warm and not enough heat is lost, the temperature is kept normal by profuse sweating, flushed skin, and deeper breathing.

In cold weather, when one is suddenly exposed to cold, wearing insufficient clothing, and is therefore constantly losing heat, more heat is immediately produced by the shivering which results. Shivering is a series of fine muscular contractions or tremors, which produces enough heat to raise the body temperature to normal again.

The sensitiveness of the heat regulating center varies in different individuals. It can be tested by observing how low the temperature must be reduced in any individual, before shivering is produced, or how high the temperature must be raised, before sweating occurs.

Fever

The bacterial poisons which cause most of the infectious diseases usually affect the heat regulating center in such a way, that it keeps the heat of the body regulated for a temperature higher than normal; perhaps 102 F. or 103 F., etc.

We then have, in these infectious diseases, the higher temperature of the body as one of the symptoms of the disease. The usual temperature of that disease may be said to be its average temperature. If, however, the temperature rises several degrees above the usual, the excessive heat is eliminated by sweating, flushed skin, etc., just as in the normal individual, until the temperature is lowered again to the usual range for that particular disease.

When the temperature is lower than the usual for the particular disease, more heat is produced; by shivering, or by a chill, until the temperature is raised nearer to the usual range.

When, however, the infection is overcome, the heat regulating center is again set for its normal point: 98.6 F.

Antipyretics

Drugs lower the temperature in three different ways:

1. By lessening the production of heat. This is accom-

plished by such drugs as **quinine, morphine, aconite, etc.,** which lessen the muscular and other activities of the body.

2. **By increasing the elimination of heat.** Drugs like **pilocarpine** or **morphine** which produce sweating, and drugs which widen the blood vessels of the skin, such as the **nitrites, or the spirit of nitrous ether,** reduce the temperature in this way.

3. **By setting the heat regulating center for a temperature nearer normal,** so that the excessive heat is eliminated. When the temperature is normal, these drugs produce no effect. The analgesic antipyretics act in this way.

ANALGESIC ANTIPYRETICS

Coal Tar Antipyretics

The drugs belonging to the coal tar group were originally used to lower temperature. They are now principally used to relieve nervousness, headache and pain.

Source

The analgesic antipyretics are all made by chemical methods from coal tar. This is a thick tarry liquid which remains as a sediment, together with other substances, after coal has been distilled in the manufacture of illuminating gas.

The effects of these substances are due to **paramidophenol,** which they form in the body.

Appearance of the Patient

(Antipyrine, Acetanilid, Phenacetine)

About fifteen minutes to half an hour after an average dose of phenacetine is given, the patient is relieved of neuralgic pains or headache from which he may have been suffering. If he has temperature, it may be reduced about three degrees or even to normal in several hours, accompanied by profuse sweating. The pulse and respiration are usually not very much affected. The skin is flushed and may be moist.

ACTION

Applied to the skin or mucous membranes: Antipyrine relieves pain and acts as an antiseptic. It checks bleeding by contracting the small blood vessesls. Acetanilid is slightly irritating. Phenacetine has no local effect.

Internal Action

In the mouth the coal tar drugs have a bitter taste.

In the stomach and intestine there are no effects except nausea and vomiting which occur occasionally in fever patients.

Action after Absorption

The analgesic antipyretics are absorbed into the blood in about a half hour. Here a simpler chemical substance **paramidophenol** is formed from them which is responsible for the effects of the drug.

After absorption they affect principally the brain, the temperature, the blood and the circulation.

Action on the brain: The analgesic antipyretics are soothing to the brain. They relieve neuralgic pains, nervous headache and irritability, making the patient calm and quiet. Acetanilid frequently produces light sleep.

Action on the temperature: The analgesic antipyretics lower the temperature in fevers several degrees or even to normal, by setting the heat regulating center for a lower temperature. It usually remains down for several hours. The normal temperature is not affected.

Action on the blood: Acetanilid and phenacetine form methaemoglobin in the blood. This does not readily combine with oxygen like ordinary haemoglobin, and accounts for the cyanosis that results from large doses.

Action on the circulation: The pulse is somewhat faster at first, but large doses make it slow and weak by lessening the force of the contractions of the heart muscle. When given together with caffeine, the tendency to cause a weak and slow pulse is increased.

Action on the respiration: The breathing is somewhat more rapid at first but it may become slower.

Action on the secretory glands: The secretion of sweat is increased.

Excretion

The analgesic antipyretics are slowly eliminated from the body by the kidneys, usually in about twelve to twenty-four hours.

Idiosyncrasies

In some individuals, such as those that are anaemic, or those weakened by prolonged illness, the following unusual symptoms occasionally occur:

1. Skin eruptions: redness and itching, often swelling of the face and eyelids, which may last for several days.
2. Nausea and vomiting.
3. Cyanosis (especially after acetanilid and phenacetine).
4. Collapse.
5. Dizziness.

Poisonous Symptoms

The symptoms of poisoning may follow a single overdose in which case they appear suddenly. Usually however, they result from the continued use of some patent headache powder for the relief of headache.

Overdoses of analgesic antipyretics cause the following symptoms:

1. Cyanosis (blue color of the face and hands).
2. Shortness of breath.
3. Slow weak pulse.

The cyanosis is not as marked after antipyrine.

With larger doses, in addition to these symptoms, there may be the following:

4. Subnormal temperature.
5. Muscular twitchings.
6. Collapse.
7. Stupor.

Treatment

Usually, stopping the drug is sufficient. In severe cases the following procedures are carried out:

1. Keep the patient quiet.

2. Wash out the stomach.
3. Give demulcent drinks (oils, acacia, etc.).
4. Give oxygen to relieve the cyanosis.
5. Atropine and other stimulants are given.

Habit Formation

Many nervous patients get into the habit of taking various headache powders for the relief of nervousness and headache. The habit is most pernicious; not only because of the danger of poisonous symptoms developing, but because of the interference with the general health. The nurse should therefore discourage the use of these remedies; and only give them when other milder measures are of no avail. Continued use of the coal tar drugs causes the following symptoms:

1. Digestive disturbances.
2. Nervousness.
3. Restlessness.
4. Sleeplessness.

The last three symptoms occur especially when the drugs are suddenly discontinued.

Administration

The antipyretics are best given between meals in wine, iced brandy, syrup, or milk. Thus the rapid formation of paramidophenol is prevented and poisonous symptoms are not so apt to appear. It was formerly customary to give these substances together with caffeine, but it has now been proven that this increases the tendency to weaken the heart action.

The coal tar antipyretics or their derivatives should not therefore be given together with caffeine. Sodium bicarbonate, however, does tend to lessen the weakening action on the heart.

Antipyrine is occasionally given hypodermically. It should then be injected deep into the muscles, to prevent the formation of abscesses.

PREPARATIONS

ANTIPYRINE

Antipyrine is a white crystalline powder which is readily dissolved in water. It resembles an alkaloid in its chemical properties, combining with acids to form salts.

Antipyrine (Antipyrina)	0.3–1.3 gms	grs v–xx
Antipyrine Salicylate (Salipyrin) (**Antipyrinae Salicylas**) (Not official)	0.3–2.0 gms.	grs. v–xxx

This is a combination of antipyrine with salicylic acid. It is said to relieve rheumatic pains more efficiently than either of its constituents alone.

Ferropyrine (not official) (**Antipyrina cum Ferro**)	0.3–1.0 gm.	grs. v–xv

This is a compound of antipyrine and iron chloride which is said to check bleeding.

Tussol (not official)
(**Antipyrine mandelate**)

This is used in doses of 0.03–0.3 gm. (grs. $\frac{1}{2}$-v), to lessen nervousness.

ACETANILID (ANTIFEBRINE)

Acetanilid is a white crystalline powder formed by the action of glacial acetic acid, on anilin, a chemical substance which is an ingredient of many dyes. It is a neutral substance and does not form salts with acids. Chemically it is **phenylacetamid.** It is not readily dissolved in water.

Acetanilid (Acetanilidum)	0.06–0.6 gm.	grs. i–x
Compound Acetanilid Powder (**Pulvis Acetanilidi Compositus**)	0.5 gm.	grs. viii

This consists of 7 parts of acetanilid, 1 part of caffeine and 2 parts of sodium bicarbonate.

ACETPHENETIDIN (PHENACETINE)

Phenacetine or acetphenetidin, is a white crystalline powder made from coal tar.

Phenacetine (Acetphenetidinum)	0.3–1.0 gm.	grs. v–xv
Thermodin or Phenacetine Urethane (not official) (Acetylparethoxy)	0.3–1.0 gm.	grs. v–xv

This is a compound of phenacetine and urethane. Its effects are similar to those of phenacetine.

NEW AND NON-OFFICIAL ANTIPYRETICS

There are a large number of drugs made from coal tar, which are frequently used as antipyretics, but they are not official. Many of them are said to be safer than either antipyrine, acetanilid, or phenacetine. Only the most important ones are given here, and new ones are constantly being made.

Many patent headache powders contain coal tar antipyretics, and these frequently produce poisonous effects from continued use.

PYRAMIDON

Pyramidon is an artificial chemical substance which acts like antipyrine. It relieves nervous pains and headaches. It reduces temperature slowly, but the temperature stays down longer. In large doses it weakens the heart action.

Preparations

Pyramidon (Dimethylaminoantipyrina)	0.06–0.4 gm.	grs. i –vi
Pyramidon Acid Camphorate	0.6 –1.0 gm.	grs. x –xv
Pyramidon Neutral Camphorate	0.5 –0.8 gm.	grs. viii–xii

The last two preparations are said to be safer than pyramidon.

Triphenin	0.3–1.0 gm.	grs. v–xv

This is a derivative of phenacetine. It acts like phenacetine, but its effects are slow and milder.

PHENOCOLL

Phenocoll is an artificial chemical substance which acts like phenacetine, but it is said to be safer. It has been used as a substitute for quinine, in malaria.

Preparations

Phenocoll Hydrochloride	0.3–1.3 gm.	grs. v –xx
Phenocoll Salicylate	1.0–2.0 gms.	grs. xv–xxx

This combines the effect of phenocoll with salicylic acid, and is used to relieve rheumatic pains.

Salocoll	0.5–1.0 gm.	grs. viii–xv

The following less important unofficial antipyretics are occasionally used. Their effects are similar to those of the other antipyretics.

Thalline	0.2 –0.5 gm.	grs. iii–viii
Exalgine	0.06–0.6 gm.	grs. i –x

This resembles acetanilid in its action, but it is said to be safer. It occasionally causes dizziness, twitching and weakness of the eyelids.

Lactophenine	0.5–1.0 gm.	grs. viii–xv
Thermodine	0.5–1.0 gm.	grs. viii–xv
Neurodine	0.5–1.0 gm.	grs. viii–xv
Malakine **Saliphen** **Salophen**	0.5–1.0 gm.	grs. viii–xv

These substances decompose in the body, forming salicylic acid. They therefore relieve rheumatic pains, besides lowering the temperature. Malakine occasionally produces sweating.

Antikamnia **Antinervine** (Consisting of ammonium bromide, salicylic acid and acetanilid.) **Benzanilide** **Exodyne** **Phenolide** **Analgen**	0.6–1.0 gm.	grs. x–xv
	These are proprietary preparations which produce the same effects as acetanilid.	
Hydracetine **Iodophenine** **Methacetine** **Thymacetine**	0.2–0.6 gm	grs. iii–x
	These are proprietary preparations which act like phenacetine.	
Asaprol	0.3–2.0 gms.	grs. v–xxx

This relieves pain, reduces temperature, checks bleeding, lessens nervousness, produces sleep, and increases the flow of urine. It occasionally increases the perspiration. It is often used as lotions of 1–5% solutions.

Migrainin	1.0 gm.	grs. xv

This consists of antipyrine, caffeine and citric acid.

USES OF THE ANTIPYRETICS

The antipyretics were originally used principally to reduce fever. Most of them weaken the heart action, and form methaemoglobin. They are therefore, not used for this effect as much as they formerly were. Cold baths, cold sponges, etc., have taken their place. These are preferable to reduce fever, as they do not affect the heart or blood.

The antipyretics are very useful drugs, however, and are now principally used to relieve indefinite pains and nervous headaches.

Better results are often obtained by combining small doses of several of these drugs, instead of giving an average dose of a single one. They are best given in whiskey or with sodium bicarbonate.

They should not be given together with caffeine since this increases the tendency to weaken the heart action.

CHAPTER XXI

ANTISPASMODICS

(Antihysterics)

Antispasmodics or Antihysterics are drugs which relieve "nervousness." Nervousness is a group of symptoms which occur in hysteria and neurasthenia. In these conditions patients are more susceptible to all sensory impulses, and they are more emotional. They are usually restless, they lack concentration, and suffer from sleeplessness. They are more irritable and have all sorts of indefinite pains and aches. These symptoms are relieved by many of the drugs in this group in an unknown way; probably by suggestion. Most of the substances have a very strong unpleasant odor, which makes the patients think they are taking a very efficient remedy and the symptoms therefore improve.

Because these drugs often relieve the nervous twitchings of the muscles, as well as the other symptoms of neurasthenia or hysteria, they are often called antispasmodics.

VALERIAN

Valerian is obtained from the roots and underground stems of the **Valeriana officinalis,** a European plant. Its active principle is a volatile oil which has a very unpleasant odor, especially when it is old. It also contains valerianic acid and other substances. It was formerly used in England as a perfume.

Appearance of the Patient

After a preparation of valerian is given, the patient becomes calm and quiet and his nervousness is lessened.

ACTION

Valerian has no local action.

When given internally, it produces the following effects:

1. It has an unpleasant taste and odor, it checks the formation and aids in the expulsion of gas from the stomach (carminative action).

2. It allays nervousness, and makes the patient calm and quiet; probably because of its unpleasant taste and odor.
3. It makes the pulse a little faster and stronger.
4. It is said to increase the sweat and the urine.

Preparations

Fluidextract of Valerian (Fluidextractum Valerianae)	2.0–4.0 c.c.	ʒ ½–i
Tincture of Valerian (Tinctura Valerianae)	4.0–12.0 c.c.	ʒ i –iii
Ammoniated Tincture of Valerian (Tinctura Valerianae Ammoniata)	4.0–12.0 c.c.	ʒ i –iii

New and Non-official Preparations

Valyl (Valeryldiethylamidum)	0.12 gm.	grs. ii

This usually comes in "pearls," two or three of which are given after meals.

Validol (Menthyl Valerianate)	0.6–1.0 c.c.	m. x–xv

This is a compound of menthol and valerianic acid. It acts like valerian, but is much more pleasant to the taste and has a marked carminative action. It is best given in 10 to 15 drop doses on a lump of sugar.

Validol Camphorate	0.6–1.0 c.c.	m. x–xv

This acts like validol, but because of the camphor which it contains, it is somewhat strengthening to the heart, and it relieves pain when locally applied.

Bornyval	0.25–0.75 c.c.	m. iv–xii

This is **Borneol isovalerate**, which forms a large part of the oil of valerian, the active principle of valerian.

Brovalol	0.25–0.75 c.c.	m. iv–xii
Gynoval	0.25–0.5 gm.	grs. iv–viii

This acts like valerian but it is more pleasant to take.

COMPOUND SPIRITS OF ETHER (HOFFMAN'S ANODYNE)

Compound spirits of ether, or Hoffman's anodyne, **is used principally to lessen nervousness** and calm the patient. It also checks the formation of gas in the stomach. Its effect is due principally to the ethereal oil, or oil of wine, which it contains. This is a substance which is formed by distilling alcohol with sulphuric acid and then diluting the resulting fluid with ether.

Preparations

Compound Spirits of Ether (Spiritus Aetheris Compositus) (Hoffman's Anodyne)	2.0–4.0 c.c.	ʒ ½–i

The following preparations are occasionally used to relieve nervousness and to make the patient calm and quiet.

Acetic Ether (Aether Aceticus)	1.0 c.c.	m. xv

This resembles ether, but it does not readily evaporate.

MONOBROMATED CAMPHOR (CAMPHORA MONOBROMATA)

This resembles camphor in its action. It is given in doses of 0.3–1.0 gm. (grs. v–xv).

Camphor itself is also used to lessen nervousness and quiet the patient.

MUSK (MOSCHUS)

Musk is the dried secretion of the glands situated in front of the prepuce of the **Moschus moschiferus**, or the musk deer of Thibet. It is a dark brown substance, with a very strong characteristic odor.

ACTION

Owing to the difficulty of obtaining a reliable preparation, musk often produces no effects. If the preparation is a good one, it produces the following effects:

1. **It relieves nervousness** and calms and quiets the patient.

2. It is said to make the pulse stronger and faster.
3. It often relieves hiccough.

Larger doses have occasionally caused headache, dizziness, confusion, and muscular twitchings, followed by sleep.

Preparations

Musk (powder) **(Moschus)**	0.5–1.0 gm.	grs. viii–xv
Tincture of Musk (Tinctura Moschi)	4.0–8.0 c.c.	ʒi–ii

HUMULUS LUPULUS (HOPS)

Hops are the dried cones which consist of scales, of the **Humulus lupulus**, or hop vine, a plant growing in England, northern Europe, and the United States. At the base of the scales, there is a yellow powder called **lupulin.** The active principle of hops is a volatile oil.

ACTION

When locally applied, hops relieves pain and causes redness of the skin.

When taken internally, it produces the following effects:

1. It increases the appetite and aids digestion.
2. It is soothing to the brain and lessens nervousness, and may even produce light sleep.
3. It contracts mucous membranes.
4. It is said to increase the perspiration.

Administration

Hops are usually applied in the form of bags containing the crude hops. These are soaked in water, wrung out, and applied locally, or they may be heated and used dry.

Pillows made from hops are used to induce sleep.

Preparations

Lupulin (powder) **(Lupulinum)**	0.3–1.2 gm.	grs. v–xx

Fluidextract of Lupulin (Fluidextractum Lupulini)	2.0–8.0 c.c.	$3\frac{1}{2}$–ii
Oleoresin of Lupulin (Oleoresina Lupulini)	0.1–0.3 gm.	grs. $i\frac{1}{2}$–v

SUMBUL

Sumbul or vegetable musk is obtained from the root and underground stems of the **Ferula sumbul**, a plant which is very little known. Its active principle is a volatile oil.

It is used principally to allay nervousness and make the patient calm and quiet. It may be given in large doses.

Preparations

Extract of Sumbul (Extractum Sumbul)	0.25 gm.	grs. iv
Fluidextract of Sumbul (Fluidextractum Sumbul)	2.0 c.c.	m. xxx

CYPRIPEDIUM

Cypripedium is obtained from the roots and underground stems of **Cypripedium pubescens** or ladies' slipper, and from **Cypripedium parviflorum** or moccasin plant, two American plants. The active principle of these plants is a volatile oil.

It relieves nervousness and quiets the patient. It has been used as a substitute for valerian.

Fluidextract of Cypripedium (Fluidextractum Cypripedii)	1.0–2.0 c.c.	m. xv–xxx

SCUTTELARIA

Scuttelaria is obtained from the **Scuttelaria lateriflora** or skull cap, an American plant. It relieves nervousness and quiets the patient.

Fluidextract of Scuttelarium (Fluidextractum Scuttelariae)	4.0 c.c.	ʒ i

PART VI—DRUGS WHICH ACT UPON THE PERIPHERAL NERVE ENDINGS

CHAPTER XXII

STIMULANTS OF NERVE ENDINGS

Physiology of Nerve Endings

Many drugs principally affect the nerve endings; which are small microscopic structures that connect the terminations of the nerve fibers with the various tissues and organs of the body. The function of the nerve endings is to receive impulses for transmission to the spinal cord and brain when the nerve is a sensory or afferent nerve. When the nerve is a motor or secretory (efferent) nerve, its nerve endings transmit the impulses to the muscles or glands in which they are situated.

When the nerve endings are **stimulated**, the effects vary according to the kind of nerve; whether it is a sensory (afferent) nerve or a motor or secretory (efferent) nerve.

Stimulation of secretory nerve endings increases the secretion of the glands in which these nerve endings are situated, because the nerve endings then receive impulses for secretion more readily.

Stimulation of motor nerve endings increases the contractions of the various muscles in which the nerve endings are thus affected, because impulses for contraction of these muscles are received more readily.

Stimulation of sensory nerve endings increases the appreciation of the sensations carried by these nerves; thus, an ordinary sensation of touch may be appreciated as a tingling sensation. Practically, no drugs are used to produce this effect.

When the sensory nerve endings are stimulated, reflex action is increased, because impulses to the spinal cord are started more readily.

Depression of Nerve Endings

When the nerve endings are **depressed,** the following are the effects on the secretory, motor (efferent) and sensory (afferent) nerves.

Depression of secretory nerve endings lessens the secretion of the glands in which the nerve endings have been affected, because impulses for secretion are not so readily received.

Depression of motor nerve endings lessens the contractions of the muscles in which the nerve endings have been affected, because impulses for the contraction of these muscles are not as readily received.

Depression of the sensory nerve endings lessens the appreciation of the various sensations, which are then not as readily appreciated. Numbness and insensibility to pain are produced when the sensory nerve endings of the skin are thus affected.

Since impulses are not able to be readily started when sensory nerve endings are depressed, substances which produce this effect also lessen reflex action.

The drugs that lessen the action of the sensory nerve endings are used principally as local anaesthetics.

SECRETORY STIMULANTS

Secretory stimulants are drugs whose principal action is to increase the secretions of the secretory glands. Practically these substances are used only to increase the secretion of sweat.

DIAPHORETICS

Diaphoretics are drugs used principally to increase the secretion of sweat.

PILOCARPUS OR JABORANDI

Pilocarpus or jaborandi is obtained from the leaves of the **Pilocarpus jaborandi,** or **Pilocarpus microphyllus,** a Brazilian shrub. Its active principle is an alkaloid, **pilocarpine.** The preparations of pilocarpine, the alkaloid, are principally used. It has an odor resembling hay.

Appearance of the Patient

About five to fifteen minutes after a dose of pilocarpine is given, all the secretions are increased. The patient sweats profusely, there is a profuse flow of saliva, of tears, and of mucus from the nose, mouth and bronchi. The face is flushed, the pupils are contracted, and there is difficulty in seeing distant objects. The breathing is faster, and the pulse is somewhat more rapid and weaker. Later there may be diarrhoea.

ACTION

Local action: Applied to the skin, pilocarpine produces no effects, but it is readily absorbed from such local applications. It frequently increases the growth of hair on the scalp, whether it is applied locally or given internally. This is probably due to the increase in the secretions of the scalp. The hair is usually lighter in color and grows in patches. **On mucous membranes:** It is readily absorbed, but does not affect them locally. For example, the application of a drop of pilocarpine solution causes only general or systemic effects.

Internal Action

In the mouth: Pilocarpine has a bitter taste.

In the stomach: It increases the secretion of the mucous membrane, and greatly increases the peristalsis of the stomach. In large doses it often causes nausea and vomiting.

In the intestines: Pilocarpine increases the secretion of the mucous membrane and the peristaltic contractions of the muscle wall. Frequent movements of the bowels therefore often result.

Action after Absorption

Pilocarpine is very rapidly absorbed into the blood from the stomach, and from all the mucous membranes upon which it is applied; usually in about fifteen minutes. After absorption it affects principally the secretory glands, the involuntary muscles, the pupils, the heart and respiration.

Action on the secretory glands: This is the most important effect of pilocarpine. **It increases the secretions of all the secretory glands,** except those of the breasts, the liver, and the kidneys.

The secretion of the sweat glands is greatly increased (diaphoretic action). It is used principally to produce this effect. The great activity of the sweat glands makes the skin very red. About ʒx–xv of sweat are secreted after one dose of pilocarpine, and the effect lasts for about three to five hours.

There is usually a profuse secretion of saliva, of tears, of mucus from the nose, and bronchi. The secretion of the mucous membrane of the stomach and intestines is also increased. The secretion of milk, bile and urine, however, is not affected.

The effect on the secretory glands is the result of increased activity of the nerve endings for secretion in the various glands of the body. These nerve endings become more sensitive and receive impulses for secretion more readily.

Action on the involuntary muscles: In large doses pilocarpine increases the contractions of all the involuntary muscles, by increasing the activity of the nerve endings in these muscles. These nerve endings then become more sensitive and receive impulses for the contraction of the muscles more readily.

The contractions of the involuntary muscles of the stomach and intestines (peristalsis) are increased. The contractions of the involuntary muscles of the bronchi which result from pilocarpine, make the bronchi narrower, so that the patient must breathe faster and deeper to inhale a sufficient amount of air. The contractions of the involuntary muscles of the bladder, often cause frequent urination accompanied by straining.

The spleen and uterus are also contracted by pilocarpine.

Action on the pupil: Pilocarpine contracts the pupil. The effect on the pupil is due to the increased contractions of the involuntary circular muscles of the iris of the eye, which make the pupil smaller. The contractions of the ciliary

muscle of the eye, make the lens more convex, so that the patient sees only near objects, and has great difficulty in seeing distant ones. Pilocarpine also makes the eyeball softer, by causing a free circulation of fluid from the posterior to the anterior chamber of the eyeball. It is often used to produce this effect in glaucoma, a disease in which the eyeball becomes hardened and which often causes blindness.

Action on the circulation: In large doses pilocarpine makes the heart beat slower and weaker. The pulse is therefore slow and weak. It makes the nerve endings in the heart, of the Vagus nerve, more sensitive; so that these nerve endings receive impulses to slow the heart more readily. The pulse may be somewhat stronger and faster for a few minutes. Poisonous doses dilate the small blood vessels.

Action on the respiration: The breathing becomes deeper and faster. This is due to the narrow bronchi which result from the contractions of their involuntary muscles, and the weakened heart action; as a result of which the blood accumulates in the lungs. The patient then has to breathe faster and deeper (asthmatic breathing) to get a sufficient amount of air in the lungs. Poisonous doses lessen the action of the respiratory center, thus making the breathing slow and shallow.

Effect on temperature: The profuse sweating which results from pilocarpine, usually lowers the temperature slightly.

Excretion

Pilocarpine is excreted mainly by the kidneys and sweat. It begins to be eliminated in about an hour, and is entirely excreted in about twenty-four hours.

Dangers in the Use of Pilocarpine

Pilocarpine is a very efficient drug; but its use is limited by some of the following effects, which are often injurious to the patient.

1. The slow and weak pulse.
2. The profuse secretion of mucus in the bronchi fills up the lungs with mucus, and the contractions of the in-

voluntary muscles of bronchi make them narrower. The mucus is then expelled with difficulty, and the lungs fill up with fluid. This condition is known as **oedema of the lungs.** The patient is then said to "drown" in his own sweat.

3. Patients often feel very weak and chilly after pilocarpine.

Poisonous Effects

Since pilocarpine is rapidly excreted, only acute poisoning occurs, usually from an overdose.

Symptoms

1. Great weakness.
2. Profuse secretion of saliva.
3. Profuse perspiration and flow of tears.
4. Occasionally, nausea, vomiting, abdominal pain and profuse diarrhoea, with watery stools.
5. Slow, irregular, weak pulse.
6. Rapid, difficult breathing, accompanied by "râles" (gurgling sounds in the lungs, due to the accumulation of mucus).
7. Contracted pupils.
8. Occasionally, dizziness, slight delirium, and twitchings of the muscles.

The breathing finally becomes slow and shallow, the patient complains of great weakness, and death results from failure of the respiration. Consciousness remains to the end.

Treatment

1. Atropine is given as an antidote. This paralyzes the nerve endings, which have been made more active by pilocarpine and neutralizes its effects.
2. Give artificial respiration if the breathing is slow and shallow.
3. Heart stimulants such as caffeine or camphor are usually given.

Uses

1. Pilocarpine is used principally to increase the sweat; in cases of nephritis, when the patient secretes very little

urine, and to remove fluid from the tissues (oedema). To avoid unpleasant effects from pilocarpine, the patient should be wrapped up in blankets and kept warm.

2. It is often given as a hair tonic, by local applications. The hair is the secretion of the hair follicle, and the effect is probably due to the increased secretion of this, as well as of the other secretory glands.

3. It is often given to overcome dizziness resulting from lessened secretion in the labyrinth of the ear.

Preparations

Fluidextract of Pilocarpus (Fluidextractum Pilocarpi)	0.5 –2.0 c.c.	m. viii–xxx

Pilocarpine

Pilocarpine Hydrochloride (Pilocarpinae Hydrochloridum)	0.003–0.03 gm.	gr. $\frac{1}{20}$–$\frac{1}{2}$
Pilocarpine Nitrate (Pilocarpinae Nitras)	0.003–0.03 gm.	gr. $\frac{1}{20}$–$\frac{1}{2}$

MUSCARINE

Muscarine is an alkaloid, which is the poisonous principle of various poisonous mushrooms. It produces effects exactly like those of pilocarpine. The symptoms resulting from eating poisonous mushrooms are the same as those of pilocarpine poisoning.

EUPATORIUM (THOROUGHWORT)

Eupatorium is obtained from the leaves and flowers of the **Eupatorium perfoliatum**, boneset or thoroughwort.

It is used principally to increase the perspiration. It is given as an infusion, very hot; a tumblerful at a time. The patient should be in bed, warmly covered.

OTHER DIAPHORETICS

There are a number of drugs which increase the secretion of the secretory glands, especially the sweat glands, but they

produce other more important effects. The most common ones are the following:

Ipecac (especially in the form of Dover's powder)
Antimony
Aconite
Veratrum Viride
Spiritus Aetheris Nitrosi (sweet spirits of niter)

and many of the saline diuretics, such as,

Potassium Citrate
Solution of Ammonium Acetate
Spirit of Mindererus

Most of the salicylic acid preparations also increase the perspiration.

Eunatrol (non-official) 1.0 gm. grs. xv

This is sodium oleate. It is said to increase the flow of bile.

DRUGS WHICH INCREASE THE CONTRACTIONS OF THE INVOLUNTARY MUSCLES

(Stimulants of the Motor Nerve Endings)

PHYSOSTIGMA AND ESERINE

Physostigma is obtained from the **Physostigmine venenosum**, the calabar bean, or ordeal bean. It is a large bean, growing on a vine, principally in Calabar, on the western coast of Africa.

Its active principle is an alkaloid, **eserine**, or **physostigmine**. It contains two other alkaloids, calabarine, and eseridine.

A paste made from the calabar bean has been used for generations by the natives of the Western Coast of Africa, as a test in the trials by ordeal for various crimes; such as witchcraft, etc. The accused individual was forced to eat the paste; if he died, he was guilty, otherwise he was considered innocent!

Appearance of the Patient

About fifteen minutes after giving a dose of eserine, the

patient usually complains of cramp-like pains in the abdomen and slight weakness. He often feels somewhat nauseated and the bowels move very freely, the stools being quite fluid. There is usually a profuse secretion of saliva and perspiration.

The pulse is slow and weak, and the breathing is at first somewhat rapid and deep, but later it becomes slow and shallow. The pupils are contracted, and the patient is unable to see distant objects clearly. He usually complains of weakness.

ACTION

The action of physostigma is due to the eserine which it contains. This is the preparation commonly used. The effects of eserine are quite similar to those of pilocarpine. They are due to stimulation of the nerve endings.

Local action: Applied to the skin, or mucous membranes, it produces no effects, but the drug is readily absorbed from mucous membranes.

Internal Action

In the mouth: No effects are produced.

In the stomach and intestines: It markedly increases the secretions of the mucous membranes and the peristalsis, much more so than pilocarpine does. Cramp-like abdominal pains with frequent fluid stools result.

Action after Absorption

Eserine is very rapidly absorbed into the blood from the stomach, in about fifteen minutes to a half hour. After absorption it affects principally the involuntary muscles, the pupils, the secretory glands, the circulation and the respiration.

Action on the involuntary muscles: Eserine increases the contractions of all the involuntary muscles, by increasing the activity of the nerve endings in the muscle wall. These nerve endings then become more sensitive, and receive impulses for contraction of the muscles more readily.

The muscles of the intestines are particularly affected, the peristalsis is very much increased, and frequent fluid move-

ments of the bowels result. The contractions of the muscles of the ureter, bladder and uterus, are also increased.

Action on the pupils: It contracts the pupil if applied locally to the conjunctiva, or when given internally. It makes the nerve endings of the circular muscles of the iris more sensitive, so that impulses for their contractions are more readily received.

Eserine also contracts the ciliary muscle of the eye, a muscle which holds the lens in place. The contraction of this muscle makes the lens more convex, so that the patient is unable to see distant objects clearly. It also causes a free circulation of fluid from the posterior to the anterior chamber of the eye, thereby making the eyeball softer. Eserine is often used to produce this effect in glaucoma, a disease in which the eyeball becomes hardened, and which often results in blindness.

Action on the secretory glands: Eserine increases the secretion of all the secretory glands, by making their nerve endings more sensitive to receive impulses for secretion.

The secretion of saliva, mucus from the nose and bronchi; the tears, perspiration, the pancreatic, the stomach and intestinal secretions are all increased. This effect is not very marked, however, because of the contractions of the blood vessels in the glands. These contractions tend to neutralize the stimulation by limiting the blood supply of the glands.

Action on the circulation:

On the heart: eserine makes the heart beat slower, by making the nerve endings of the Vagus nerves in the heart more sensitive to receive impulses for slowing the heart.

On the blood vessels: The contraction of the involuntary muscle fibers in the walls of the blood vessels makes the blood vessels narrower. The blood pressure is thus raised; usually, however, this effect is not very marked. **The pulse of eserine is therefore slow and strong.**

Action on the respiration: The breathing is at first rapid and deep, because of the narrow bronchial tubes. Later, it becomes slow and shallow, as a result of lessened activity of

the respiratory center in the medulla, so that fewer impulses for breathing are sent out.

Action on the spinal cord: It lessens the reflex action of the spinal cord and medulla.

Excretion

Eserine is very rapidly eliminated from the body by the urine and by all the secretions. It begins to be excreted in a few minutes, and is entirely eliminated in a few hours.

Poisonous Effects

Since eserine is very rapidly excreted, only acute poisoning occurs; usually from an overdose of the drug, given hypodermically or dropped into the eye.

Symptoms

1. Abdominal cramps.
2. Nausea and vomiting.
3. Diarrhoea, with frequent watery stools.
4. Excessive flow of saliva and perspiration.
5. Rapid, then slow, shallow, difficult breathing.
6. Slow, irregular, weak pulse.
7. Contracted pupils.
8. Twitchings of the muscles, beginning in the legs and extending to the upper extremities, with great muscular weakness.
9. Collapse.

Treatment

1. Wash out the stomach.
2. Keep the patient warm.
3. Give artificial respiration.
4. Atropine is given hypodermically. This is the antidote, as it paralyzes the overacting nerve endings, and increases the breathing.
5. The collapse is usually treated with heart stimulants.

Uses

Eserine is principally used in the following conditions:

1. To soften the eyeball in glaucoma, and to contract the pupil.

2. To increase the peristalsis, to cause frequent movements of the bowels, and to expel gas. It is frequently used for the latter effect, on patients that have just been operated upon, and who have difficulty in passing gas; especially after gynecological operations. It should be avoided when the operation has been performed upon the stomach or intestines.

3. It is occasionally used in chronic constipation.

Preparations

Physostigma

Extract of Physostigma (Extractum Physostigmatis)	0.008–0.06 gm.	gr. $\frac{1}{8}$–i
Tincture of Physostigma (Tinctura Physostigmatis)	1.0–3.0c.c.	m. xv–xlv

Eserine

Eserine Salicylate (Physostigminae Salicylas)	0.001–0.003 gm.	gr. $\frac{1}{60}$ – $\frac{1}{20}$
Eserine Sulphate (Physostigminae Sulphas)	0.001–0.003 gm.	gr. $\frac{1}{60}$ – $\frac{1}{20}$

CHAPTER XXIII

DEPRESSANTS OF SECRETORY AND MOTOR NERVE ENDINGS

SECRETORY DEPRESSANTS

BELLADONNA GROUP

The following group of drugs produce similar effects because they contain the same active principles. The active principles occurring in these plants are the following alkaloids:

Atropine
Hyoscyamine
Hyoscine

These alkaloids are closely related to one another, and some of them are compounds of still simpler alkaloids. Thus, atropine is a compound of two forms of hyoscyamine.

By decomposing atropine and combining another acid with the compounds thus formed, artificial alkaloids are formed. **Homatropine,** for example, is formed when atropine is decomposed and then combined with another acid (oxytoluic acid).

Hyoscine or **scopolamine** is also related chemically to atropine.

The drugs which contain these alkaloids all belong to the group of plants known as the **Solanaceae.** (The potato and egg plants belong to the same group.)

The following are the most important plants of the group:

Atropa Belladonna (Deadly Nightshade)

This contains **atropine,** with small quantities of **hyoscyamine** and **hyoscine.**

Hyoscyamus Niger (Henbane)

This usually contains **hyoscyamine, hyoscine,** and small quantities of **atropine.**

Datura Stramonium (Thornapple)

This contains mostly **atropine, hyoscyamine** and small quantities of **hyoscine.**

Duboisa Myoporoides
Scopola Atropoides
Mandragora Autumnalis or Atropa Mandragora (Mandrake)

These are other less important drugs which contain **atropine.**

BELLADONNA AND ATROPINE

Belladonna is a drug obtained from the leaves and roots of the **Atropa belladonna** or **Deadly nightshade.** It is a perennial plant, about three feet high, which ordinarily grows in England and other parts of Europe, but it has also been cultivated in this country.

Its active principles are the following alkaloids:

Atropine
Hyoscyamine
Hyoscine

The effects of belladonna are due principally to the atropine which it contains. This is preferred for internal use.

Appearance of the Patient

After administration of atropine, or one of the atropine containing drugs, such as belladonna or hyoscyamus, the following effects result within ten minutes to a half hour:

The patient looks brighter, the face and neck are somewhat flushed, and the pupils are dilated. He is more wakeful and brighter.

The pulse is rapid and strong and the breathing is deeper and faster. Various cramp-like pains, such as pains in the stomach, intestines, or bladder, from which the patient may be suffering, are relieved.

The patient is thirsty, complains of dryness of the mouth and throat. The skin usually feels dry, and may be quite red.

If the patient has an attack of shortness of breath, this is usually relieved.

ACTION

Local action: On the skin, atropine relieves pain, and checks the secretion of sweat. This effect is produced by paralyzing the sensory nerve endings in the skin. It is often used for this purpose in the form of a belladonna plaster. Atropine or belladonna is readily absorbed from the skin if applied in a solution of alcohol, glycerine, oil, or camphor, or in the form of a plaster. It often causes general, even poisonous symptoms from such applications. **On mucous membranes:** It checks the secretion.

Internal Action

In the mouth: Atropine has a bitter, burning taste, and checks the secretion of saliva and mucus. It makes the mouth and throat feel dry. If this effect is marked, the patient is unable to swallow.

In the stomach: It lessens the secretion of gastric juice and the peristalsis of the stomach.

In the intestines: Atropine checks the secretion of the mucous membrane of the intestines and lessens the peristaltic contractions of its muscle wall. It is often used for this purpose to check the griping pains of cathartics.

Action after Absorption

Atropine enters the blood through the mucous membrane of the stomach and intestines. It is rapidly absorbed, usually within a half to one hour. It can also be absorbed from other mucous membranes. After absorption, it is carried by the circulation of the blood to various organs of the body; but it affects principally the heart, the respiration, the brain, all the secretory glands, the involuntary muscles and the pupils.

Action on the heart: Atropine makes the heart beat faster and stronger. The systoles, or periods of contraction of the heart are increased, while the diastoles or periods of relaxa-

tion are lessened. The heart then expels more blood; and with greater force.

This effect is due to the paralysis of the nerve endings in the heart, of the Vagus or inhibitory nerves. The checking or slowing influence is then taken away from the heart, so that impulses for slowing the heart will not reach it. As a result, the accelerator nerves have full play, and the only impulses that reach the heart make it beat stronger and faster.

Action on the blood vessels: The small arteries of the abdomen are constricted by the contractions of their muscle fibers, as a result of impulses which reach them from the vaso constrictor center in the medulla of the brain. **The blood vessels of the skin, however, are widened.** This causes the flushing of the face and neck, often noticed after administration of atropine.

Atropine makes the **pulse rapid strong, and tense.** There may be a slight increase in blood pressure.

Action on the respiration: Atropine makes the breathing faster and deeper by increasing the impulses for breathing that are constantly being sent from the respiratory center of the medulla. More air, and therefore more oxygen, is taken into the lungs. The blood is then able to take up more oxygen and to eliminate the carbon dioxide more rapidly.

Action on the nervous system: Atropine increases the activity of the brain. This produces wakefulness and restlessness, because the patient is more conscious. This is due to the fact that the areas of the brain which receive sensations are made more active. More sensations are then received through the various senses. The higher intellectual activities, such as reasoning and memory are not affected, however.

The patient is more active and more talkative, because the motor and speech areas of the brain are more active, and these areas are constantly sending out more impulses.

In overdoses, atropine causes symptoms of lessened brain activity (depression), because the brain then becomes exhausted from overactivity.

Action on the secretory glands: Atropine lessens the secretion of all the secretory glands, as a result of lessening the action of the nerve endings of the secretory nerves in the various glands.

Effect on Secretions

Gland	*Secretion*	*Effect*
Digestive glands	Saliva	Lessened; excessive thirst
	Gastric juice	Lessened
	Intestinal secretions	Lessened
	Pancreatic juice	Only water lessened. Secretion of its digestive ferments are not due to nervous influences, but to chemical substances formed in the stomach (secretin)
	Bile	Lessens change of glycogen to sugar
Mucous glands	Mucus	Lessened
Kidneys	Urine	No effect

Action on the involuntary muscles: Atropine lessens the contractions of all the involuntary muscles, by paralyzing the nerve endings of the nerves which carry impulses to these muscles. Thus, the peristalsis of the stomach and intestines, the contractions of the bladder, of the uterus, and of the bronchial muscles are all lessened by atropine.

(Atropine, or drugs containing atropine, are often used to relieve contractions of the small muscle fibers of the bronchi which often produce asthmatic attacks.)

Action on the pupil: Atropine dilates the pupil by paralyzing the nerve endings of the nerves in the circular muscle fibers of the iris, or colored part of the eye. The radial muscles then have free play, and their contractions widen the pupil. The pupil may remain dilated for days.

Patients are often unable to see near objects clearly after atropine has been dropped into the eye. This is due to the paralysis of the nerve endings of the ciliary muscle, a muscle which changes the contour of the lens for near and distant objects (accommodation). The relaxation of this muscle

prevents the lens from changing its contour for near objects, which cannot then be seen.

Effect on the temperature: In large doses atropine often causes a rise of temperature.

Excretion

Atropine or a drug containing atropine, is excreted mainly by the kidneys. It is eliminated in about ten to twenty hours. Part of the drug is oxidized and used up in the body.

Idiosyncrasies

The following unusual effects occasionally occur:

1. Ordinary doses of atropine sometimes cause delirium.
2. When applied to the conjunctiva of the eye, atropine often causes inflammation of the eyelids and face.
3. The rash caused by atropine may spread all over the body, and the skin may peel (desquamate). It may be mistaken for scarlet fever.

Poisonous Effects

Acute atropine poisoning usually results from excessive doses of atropine or drugs containing atropine. Dangerous symptoms have resulted from gr. $\frac{1}{20}$–$\frac{1}{10}$ and death has occurred in about six hours after it was taken.

Since atropine is rapidly excreted, cumulative symptoms, or chronic atropine poisoning does not occur.

Symptoms

In giving atropine or atropine containing drugs the nurse should watch for **excessive thirst** and **talkativeness**. She should report these symptoms to the physician as soon as they occur.

The earliest and most characteristic symptoms of atropine poisoning are the following:

1. **Dryness of the mouth and throat.**
2. Excessive thirst.
3. Difficulty in swallowing.
4. Hoarseness.

5. **Flushed, dry skin,** especially of the face and neck.
6. **Very rapid pulse and breathing.**
7. **The pupils are widely dilated** and near objects cannot be seen distinctly.

If very large doses of atropine are taken, these symptoms are increased and may be followed by:

1. Hoarseness, with difficult and indistinct speech, and talkativeness.
2. Restlessness and wakeful delirium.

The patient is very talkative, but his ideas are confused. He may begin a sentence and not finish it. He is very light-headed, may burst into fits of laughter or tears. Occasionally there may be illusions or hallucinations of sight. Patients therefore often seem to see various objects about them.

Soon **a peculiar, wakeful, active, and talkative delirium** develops. The patient lives in a world of his own; he talks to objects and persons which he seems to see about him. He is entirely oblivious to the real objects about him. Often he is quarrelsome, even maniacal, and has to be restrained.

The excitement is usually followed by collapse: the skin becomes pale, cold and clammy, the pulse becomes rapid and weak, the breathing slow and shallow, and death may result.

Frequently the excessive excitement is followed by stupor and coma, with slow and shallow breathing and cyanosis.

Finally, tremors of the muscles and **convulsions** develop, the breathing becomes slow and shallow, the face becomes blue, and the patient dies from paralysis of respiration.

Although atropine is a respiratory stimulant, the nurse should remember that from poisonous doses the respiratory center becomes depressed and may finally be entirely paralyzed and death ensue.

Treatment of Atropine Poisoning

1. Wash out the stomach, or give emetics.
2. Give tannic acid or old tea to combine with the atropine and neutralize it.
3. Catheterize the patient, to avoid reabsorption of the

atropine from the urine in the bladder, especially since patients suffering from atropine poisoning do not pass much urine.

5. Keep the body warm; give mustard baths.

6. Give artificial respiration if the breathing is embarrassed.

7. Stimulants, such as caffeine, strychnine, are usually given.

8. **Do not give morphine;** for, while atropine is the antidote for morphine, the dangerous effects of atropine are due to the exhaustion of the breathing. If morphine is given in such cases, the breathing is only made slower. Morphine, is not therefore an antidote for atropine, though atropine is an antidote for morphine.

Uses

The following are the most important uses of atropine or belladonna:

1. In the form of a belladonna plaster or liniment, atropine or belladonna is used to relieve pain, on the site where it is applied.

2. As a cardiac and respiratory stimulant, especially where immediate effects are desired.

3. As an antidote for morphine poisoning. It is very often given together with morphine to avoid poisonous effects.

4. Atropine is often given to check secretions, for example, to check profuse sweating, or the secretion of milk.

5. To lessen cramp-like pains produced by contractions of involuntary muscles. **It is often prescribed together with purgatives to lessen their griping. It relieves the colic** which is produced by the contractions of the involuntary muscles of the bile ducts resulting from the passage of a gall stone along these ducts. It also relieves the colic of the ureters of the kidney (renal colic) resulting from the passage of a stone or other substance along the ureter.

By lessening the contractions of the involuntary muscles of the stomach, **it often relieves the pains of an ulcer in the stomach.**

It frequently relieves painful urination produced by the

spasmodic contractions of the involuntary muscles at the neck of the bladder.

6. Atropine is very often used to relieve bronchial asthma. It is particularly valuable in this condition, because it lessens the spasms of the involuntary muscles of the bronchi, and at the same time it checks the secretion of its mucous membranes.

7. Atropine is very often used to dilate the pupil, so that the retina or background of the eye may be more easily examined, and to prevent adhesions between the iris and lens, when the iris is inflamed.

8. It is very often used in diabetes in large doses. It lessens the amount of sugar in the urine. The reason for this effect is unknown, but it may be due to lessened formation of sugar from the liver cells.

Preparations

Preparations Made from the Leaves

For Internal Use

Extract of Belladonna Leaves 0.005–0.03 gm. gr. $\frac{1}{12}$–$\frac{1}{2}$
(Extractum Belladonnae Foliorum)

Tincture of Belladonna Leaves 0.3 –1.0 c.c. m. v–xv
(Tinctura Belladonnae Foliorum)

For Local Use

Belladonna Ointment
(Unguentum Belladonnae)

This contains about 10% of the extract of belladonna.

Belladonna Plaster
(Emplastrum Belladonnae)

This contains 3 parts of the extract of belladonna and 7 parts of adhesive plaster.

Preparations Made from Belladonna Root

For Internal Use

Fluidextract of Belladonna Root 0.06–0.12 c.c. m. i–ii
(Fluidextractum Belladonnae Radicis)

For Local Use

Belladonna Liniment
(Linimentum Belladonnae)

This consists of the fluid extract to which has been added about 5% of camphor.

Preparations of Atropine

For Internal Use

Atropine (Atropina)	0.0004–0.001 gm.	gr. $\frac{1}{100}$–$\frac{1}{60}$
Atropine Sulphate (Atropinae Sulphas)	0.0004–0.001 gm.	gr. $\frac{1}{100}$–$\frac{1}{60}$

For hypodermic use, atropine often comes in tablets, each containing the required dose, or in ½ to 1% solutions.

For Local Use

Oleate of Atropine
(Oleatum Atropinae)

This contains about 2% of atropine.

Atropine Ointment
(Unguentum Atropinae)
(Not official)

This contains about 4% of atropine.

Homatropine

Homatropine is an artificial alkaloid of atropine. It is formed by a combination of tropine, an alkaloid obtained by decomposing atropine, with oxytoluic acid.

The effects of homatropine are similar to those of atropine. It dilates the pupil more rapidly than atropine, and the effect is not as lasting. It is not so apt to cause general symptoms as easily as atropine from its local use; as in applications to the eye.

Homatropine is used principally to dilate the pupil, by dropping a solution of the drug into the conjuctiva of the eye.

Preparations

Homatropine Hydrobromide (Homatropinae Hydrobromidum) 0.0006–0.001 gm. gr. $\frac{1}{100}$–$\frac{1}{60}$

This is used principally in $\frac{1}{2}$ to 1% solutions for local applications to the eye.

STRAMONIUM (THORNAPPLE, JAMESTOWN WEED)

Stramonium is obtained from the leaves of the **Datura stramonium**, a weed growing in England and the United States. It is known by various names, such as Jamestown weed, thornapple, or gypsum. Its active principles consist mostly of **hyoscine** but it also contains **atropine** and **hyoscyamine.**

Appearance of the Patient

Stramonium is usually given to patients suffering from an attack of spasmodic asthma.

When a preparation of stramonium is given, or the fumes of burnt stramonium leaves inhaled, the patient is relieved of the asthmatic attack. The breathing is easier, the pulse is strong and rapid. The patient complains of dryness of the mouth and throat and is very thirsty. The pupils are dilated, and the patient is somewhat more active and more talkative.

Administration

Stramonium is given in the form of cigarettes, which are smoked during an attack of asthma, or the leaves are burned in a saucer and the smoke inhaled. It relieves the attack by relaxing the spasm of the involuntary muscles of the bronchi.

Preparations

Stramonium leaves made up into cigarettes, or the plain dried leaves are the most commonly used preparations.

Extract of Stramonium (Extractum Stramonii) 0.015–0.03 gm. gr. $\frac{1}{4}$–$\frac{1}{2}$

Fluidextract of Stramonium (Fluidextractum Stramonii) 0.06 –0.12 c.c. m. i–ii

Tincture of Stramonium (Tinctura Stramonii)	0.3–1.0 c.c.	m. v–xv
Stramonium Ointment (Unguentum Stramonii)		

This contains 10% of the extract of stramonium. It is used principally for painful haemorrhoids.

HYOSCYAMUS

Hyoscyamus is obtained from the leaves and flowering tops of **Hyoscyamus niger** or **henbane,** when the plant is two years old. It grows best in England, but it has been successfully cultivated in the United States. It contains mostly **hyoscyamine,** also **hyoscine** and small quantities of **atropine.**

Hyoscyamine and hyoscine are chemically very much like atropine.

The effects of hyoscyamus are quite similar to those of belladonna and atropine, except that they are much weaker.

Preparations

Extract of Hyoscyamus (Extractum Hyoscyami)	0.03–0.2 gm.	grs. ½–iii
Fluidextract of Hyoscyamus (Fluidextractum Hyoscyami)	0.2–0.6 c.c.	m. iii–x
Tincture of Hyoscyamus (Tinctura Hyoscyami)	1.0 –4.0 c.c.	m. xv–℥i

HYOSCYAMINE

Hyoscyamine is very rarely used. Its effects are the same as those of atropine, to which it is very closely related. It lessens the contractions of all the involuntary muscles more than atropine does.

Preparations

Hyoscyamine Sulphate (Hyoscyaminae Sulphas)	0.0005–0.001 gm.	gr. $\frac{1}{120}$–$\frac{1}{60}$
Hyoscyamine Hydrobromide (Hyoscyaminae Hydrobromidum)	0.0005–0.001 gm.	gr. $\frac{1}{120}$–$\frac{1}{60}$

HYOSCINE OR SCOPOLAMINE

Appearance of the Patient

About a half to one hour after the administration of hyoscine, the patient feels tired and drowsy. He becomes less active, less talkative and soon falls asleep. The sleep resembles the normal sleep, and lasts from about five to eight hours, though the patient may feel drowsy for some time after that. The pulse and breathing are slow, and the pupils are dilated. When the patient awakes, he usually complains of dryness of the throat and mouth, and is very thirsty.

Hyoscine produces sleep more easily, if the room is darkened and loud noises avoided.

ACTION

The action of hyoscine resembles that of atropine with the following differences:

1. **Action on the pupil:** It dilates the pupil more rapidly than atropine, but the effects last for only a short time.

2. **Action on the heart:** It makes the heart beat slower. **The pulse is therefore slower after hyoscine.**

3. **Action on the respiration:** Hyoscine does not increase the breathing as much as atropine does.

4. **Action on the brain:** The activity of the brain is lessened by hyoscine. It **produces sleep,** by lessening the action of the sensory areas of the brain. Fewer sensory impressions are then received, consciousness is therefore lessened and sleep produced. It lessens especially the remembrance of various sensations. A patient may not remember having seen certain objects or having had pain.

The action of the motor and speech areas of the brain is also lessened. The patient is then less active, less talkative and feels tired.

Occasionally, there is a short period of excitement before the patient falls asleep. He may feel dizzy and be quite active, though the movements are unsteady, and the speech becomes difficult and indistinct.

Excretion

Hyoscine is excreted mainly by the kidneys, more rapidly than atropine, usually in about eight to ten hours.

Tolerance

Patients may get accustomed to hyoscine, so that large doses may be given without producing any effects.

Poisonous Effects

The poisonous effects of hyoscine are similar to those of atropine. The patient has the characteristic symptoms of **wild talkative delirium, dryness of the throat and mouth, dilated pupils, dry red skin, rapid pulse, and breathing, etc.**

Uses

Hyoscine is usually given hypodermically, to produce sleep; especially in cases of delirium, mania, delirium tremens, etc. It may cause collapse, however.

SCOPOLAMINE MORPHINE ANAESTHESIA

(Twilight Sleep)

Hyoscine or scopolamine is given together with morphine to produce a state of mild unconsciousness or anaesthesia, so as to enable the performance of painless operations. It may be used alone or as a preliminary to a general anaesthetic.

It has recently been used, however, for painless childbirth. The method, which is commonly known as "twilight sleep" consists in inducing the following effects:

1. A drowsy state in which the consciousness, as well as the sense of pain is lessened.
2. A loss of memory for pain.

Method of Administration

The desired condition is brought about by giving a dose of hyoscine with morphine as soon as labor pains start. The hyoscine alone is then repeated every hour; but each time in a smaller dose.

The effect of the drug is enhanced by darkening the room and maintaining calm and quiet surroundings.

To determine whether the desired effects are obtained, the nurse should test the patient's memory about every half hour, throughout the administration: by showing the patient the same object at frequent intervals. When the patient does not remember the object seen, the desired effect is obtained. The same object should not be shown too often, however, as the test may then become unreliable. During treatment, the patient should be carefully watched, for symptoms of collapse and poisoning (atropine poisoning). Many patients are delirious throughout the treatment, although they do not remember the pains.

Preparations

Hyoscine Hydrobromide (Hyoscinae Hyodrobromidum)	0.0003–0.0006 gm.	gr. $\frac{1}{200}$–$\frac{1}{100}$
Scopolamine Hydrobromide (Scopolaminae Hydrobromidum)		

This is the same as hyoscine hydrobromide.

Euscopole (not official)	0.0003 gm.	gr. $\frac{1}{200}$

This has a milder action than scopolamine.

SCOPOLA

Scopola is obtained from the underground stems of the **Scopola atropoides,** a plant which grows on the hills of central and southern Europe. It acts like atropine but has a soothing effect on the brain.

Preparations

Extract of Scopola (Extractum Scopolae)	0.015–0.03 gm.	gr. $\frac{1}{4}$–$\frac{1}{2}$
Fluidextract of Scopola (Fluidextractum Scopolae)	0.06–0.12 c.c.	m. i–ii

Scopolamine hybrodromide is the same as hyoscine hydrobromide and is given in doses of 0.0003–0.0006 gm. gr. $\frac{1}{200}$–$\frac{1}{100}$

DUBOISIA

Duboisia is obtained from the **Duboisia myoporoides,** an Australian shrub. Its active principle is **duboisine,** an alkaloid which at one time consists of hyoscyamine and at other times of hyoscine. It is used to soothe nervous excitability. Its action is like that of hyoscyamus. It is not often used.

MANDRAGORA (MANDRAKE)

Mandragora is obtained from the **Atropa mandragora,** or **Mandragora autumnalis** or mandrake. Its active principles are **hyoscine,** and other alkaloids. It resembles hyoscyamus in its action. It is rarely used.

PAPAVERINE

Papaverine is one of the alkaloids obtained from opium. Papaverine acts like morphine only to a very slight degree. It relieves pain and lessens the activity of the brain only slightly but it is somewhat of a local anaesthetic.

Recently however, it has been found to have a marked effect upon the involuntary muscles. It lessens the contractions of all involuntary muscles such as those of the stomach, the ureters, gall ducts, and intestines.

It is therefore used to lessen the pains caused by the spasm of the involuntary muscles in ulcer of the stomach, gall stone colic; kidney colic, painful menstruation and painful urination. It is also used to lower blood pressure and to lessen the convulsions in eclampsia.

Papaverine does not induce a habit.

Preparations

Papaverine **Papaverinae**	0.03–0.08 gm.	gr. $\frac{1}{2}$–$1\frac{1}{3}$
Papaverine Hydrochloride **Papaverinae hydrochloridum**	0.03–0.08 gm.	gr. $\frac{1}{2}$–$i\frac{1}{3}$

This also comes in tablets each containing 0.04 gm.

Papaverine sulphate **Papaverinae sulphas**	0.03–0.08 gm.	gr. $\frac{1}{2}$–$i\frac{1}{3}$

BENZYL BENZOATE

Benzyl benzoate is a colorless oily liquid formed by the combination of benzyl alcohol with benzoic acid. (Such a compound, formed by the combination of an alcohol with an organic acid is called an ester.) Benzyl benzoate may be obtained by the distillation of balsam of Peru or the balsam of Tolu. It is also present in various other balsams and in the volatile oils of various flowers such as gardenias, jasmine, tuberose, hyacinth and orange blossoms.

ACTION

Benzyl benzoate, like papaverine acts principally on the involuntary muscles, but it is much more efficient. It relieves the spasm of all involuntary muscles such as those of the intestines, the gall bladder, the ureters, the bronchi and the blood vessels.

It is used principally to check the pains due to spasm in gall stone colic, kidney colic and abdominal cramps. It is also used to check diarrhoea in chronic dysentery and mucous colitis and to lower blood pressure.

Administration

Benzyl benzoate has a very unpleasant taste. It should therefore be given in a thick syrup. It is usually prescribed in the form of a thick mixture with mucilage of acacia and flavored with a syrup or an elixir such as the elixir of lactopeptone or the Elixir of Eriodyctyon.

Preparations

Benzyl benzoate	0.6–2-0 c.c.	m. x–xxx

Benzyl benzoas

This is a liquid which is a 20% alcoholic solution.

OTHER SECRETORY DEPRESSANTS

AGARICUS AND AGARICIN

Agaricus is a fungus, the **white agaric,** or **Agaricus albus** or **Boletus laricis,** which grows on the European larch tree. Its active principle is an acid, **agaric acid,** or **agaricin,** which is the preparation principally used.

ACTION

Agaricin checks the secretion of sweat, by paralyzing the nerve endings in the sweat glands which cause secretion. The effect, however, is not as marked as that of atropine. Secretions of the other secretory glands are not affected by agaracin. It often causes nausea and frequent movements of the bowels. It does not affect the heart, respiration or pupils. It is used principally to check the night sweats of tuberculosis. It should be given about 4 or 5 hours before the expected sweat.

Preparations

Agaricin 0.005–0.06 gm. gr. $\frac{1}{12}$–i

This is best given in pill form about five or six hours before retiring, as it is very slowly absorbed.

Agaric Acid (not official) 0.015–0.03 gm. grs. $\frac{1}{4}$–$\frac{1}{2}$
(**Acidum Agaricum**)

This is a very poisonous substance. Overdoses cause vomiting, diarrhoea and collapse.

CAMPHORIC ACID

Camphoric acid is a small white crystalline powder, formed by the action of nitric acid on camphor. It is used to check sweating.

Camphoric Acid 1.0–2.0 gms. grs. xv–xxx
(**Acidum Camphoricum**)

THALLEIN ACETATE 0.06–0.2 gm. grs. i–iii

This is a white crystalline powder used to check night sweats. Its continued use is said to cause baldness.

MOTOR DEPRESSANTS

GELSEMIUM

Gelsemium is obtained from the roots and underground stems of the **Gelsemium sempervirens,** yellow jasmine, or Carolina jasmine, a climbing plant of the southern United States. Its active principles are two alkaloids: **gelsemine** and **gelseminine,** the gelsemine being the more active of the two.

Appearance of the Patient

About fifteen minutes to a half hour after giving a dose of gelsemium, the patient feels tired and languid. The pulse is perhaps somewhat slower and weaker. If the patient has had muscular twitchings, these are lessened.

ACTION

The only local effect produced by gelsemium is the dilatation of the pupil, which follows its application to the conjunctiva.

Internal Action

When taken internally, gelsemium is readily absorbed into the blood in about fifteen to twenty minutes, and it then affects principally the muscles, the respiration and slightly the heart.

Action on the muscles: Gelsemium lessens the contractions of the muscles by paralyzing their nerve endings, which receive the impulses for their contractions. In this way it **lessens muscular twitchings,** which are very fine muscular contractions.

Action on the respiration: Large doses of gelsemium make the breathing slow and shallow.

Action on the circulation: The pulse is made slower and weaker by large doses.

Excretion

Gelsemium is rapidly eliminated from the body by the urine, usually in about two to three hours.

Poisonous Effects

An overdose of gelsemium usually causes the following serious symptoms; which may often endanger the patient's life.

Symptoms

1. The patient becomes tired, languid and drowsy, but does not fall asleep.
2. The movements of the muscles become weak and unsteady, the jaw drops, the eyes may be tired, or the eyelids

may droop, and the pupils dilate. The speech is often indistinct, and the patient staggers as soon as he attempts to walk. (These symptoms are due to the beginning paralysis of the muscles.)

3. Occasionally there is nausea and vomiting with profuse flow of saliva.
4. The skin is moist, cold and insensitive to pain.
5. The pulse is slow and weak.
6. The breathing becomes very slow and shallow, and death results from the paralysis of the breathing.

The patient is conscious to the last, though there may be partial blindness before death.

Treatment

1. Wash out the stomach.
2. Keep the patient quiet.
3. Give artificial respiration.
4. Heart stimulants such as atropine, strychnine, etc., are usually given.

Uses

Gelsemium is used principally to relieve the very painful spasms of the muscles of the face in "tic douleureux" of trigeminal neuralgia.

Preparations

Fluidextract of Gelsemium (Fluidextractum Gelsemii)	0.03–0.12 c.c.	m. $\frac{1}{2}$–ii
Tincture of Gelsemium (Tinctura Gelsemii)	0.06–0.3 c.c.	m. i–v

CONIUM (SPOTTED HEMLOCK)

Conium is obtained from the fruit and flowers of the **Conium maculatum,** or poison hemlock, a European plant. Its active principle is **coniine,** a volatile fluid alkaloid.

ACTION

Applied locally, conium causes intense redness and swelling.

When taken internally, it acts like gelsemium, causing muscular weakness by paralyzing the nerve of the muscles.

In large doses it makes the breathing slower.

Poisonous Effects

Conium poisoning has become famous because it was the means with which Socrates, the famous Greek philosopher, was killed. This was the method then used in Athens to kill criminals.

Symptoms

1. The lower extremities become weak and heavy. The patient lies down because of the weakness. If he attempts to walk, he staggers and falls. The eyes may be turned in, the lids may droop, and the pupils are dilated. The patient complains of headache and he can hardly lift his head.
2. The pulse is slow at first, but soon becomes rapid and weak.
3. The skin is moist and cold.
4. The breathing becomes slow and shallow, and the patient dies in a short time from arrest of breathing.

Uses

Conium is very rarely used at present, possibly once in a great while to lessen the spasms of whooping cough. It is a very dangerous drug.

Preparations

Fluidextract of Conium (Fluidextractum Conii)	0.1–0.5 c.c.	m. ii–viii

SPARTEINE

Sparteine is a fluid alkaloid which is contained in scoparius or broom tops.

ACTION

When given internally, its effects appear in half an hour and last for several hours. It is absorbed from the stomach, and it then acts like gelsemium or conium. It weakens muscular contractions by paralyzing the nerve endings in the muscles. It is not as poisonous as either of these drugs, but it affects the heart more.

Action on the heart: Sparteine makes the heart beat slower and weaker; by weakening the contractions of the heart muscle, thereby causing a slow, weak pulse.

Sparteine was formerly considered a heart stimulant, but its use for this purpose has been given up, as its action seems to contraindicate such use.

Sparteine does not increase the flow of urine as does scoparius, the crude drug from which it is obtained.

Poisonous Effects

The poisonous effects of sparteine are the same as those of conium.

Preparations

Sparteine Sulphate (Sparteinae Sulphas)	0.004–0.1 gm.	gr. $\frac{1}{15}$–ii

LOBELIA (INDIAN TOBACCO)

Lobelia is obtained from the leaves and tops of the **Lobelia inflata** or Indian tobacco, an American plant. Its active principle is an alkaloid **lobeline.**

ACTION

When taken internally, lobelia produces the following effects:

1. It increases the secretions of the stomach and intestines, often causing nausea and vomiting, and occasionally frequent movement of the bowels.
2. **It lessens the contractions of the involuntary muscles of the bronchi.**
3. It increases the secretions; such as the saliva, the mucus from the bronchi, etc.
4. The pulse is usually slower, but soon becomes rapid and weak.
5. The breathing is somewhat slower.

Poisonous Effects

An overdose of lobelia usually causes the following symptoms:

1. Nausea, and profuse vomiting.
2. Occasionally frequent movements of the bowels.
3. Great weakness and relaxation of the muscles.

4. Collapse (rapid thready pulse, slow shallow breathing, cold moist skin, and dilated pupils).

5. Convulsions, stupor, coma and death from paralysis of the breathing.

Uses

Lobelia is occasionally used to lessen the contractions of the involuntary muscles of the bronchi, in asthma; but because of its dangerous poisonous effects, its use has mostly been given up. It is occasionally used in the form of an infusion, to relieve poison ivy rash.

Preparations

Fluidextract of Lobelia (**Fluidextractum Lobeliae**)	0.06–0.3 c.c.	m. i–v
Tincture of Lobelia (**Tincture Lobeliae**)	0.6–4.0 c.c.	m. x–3 i

TABACUM (TOBACCO) (not official)

Tobacco is the dried leaves of **Nicotiana tabacum,** a plant growing in tropical countries. It contains **nicotine,** a very poisonous volatile fluid alkaloid. It also contains **pyridine,** a substance which acts like nicotine, **tobacco camphor** and an oil.

Tobacco is not used as a medicine, but it is habitually used as a luxury by many individuals. It is smoked in the form of cigarettes or cigars, it may be chewed or taken as snuff.

ACTION

Tobacco, because of its nicotine acts like lobelia. **It lessens the contractions of all the involuntary muscles.** A strong cigar will often relieve an attack of asthma, by lessening the contractions of the involuntary muscles of the bronchi.

It increases the peristalsis and often acts as an excellent cathartic. It increases the flow of urine.

In persons who do not smoke habitually, tobacco often causes nausea, vomiting, headache, dizziness and weakness. In those who smoke habitually, it does not produce such effects.

Poisonous Effects

Nicotine is one of the most violent poisons known. It causes symptoms like those of lobelia poisoning, which come on very rapidly and cause death.

Chronic tobacco poisoning is a frequent condition which follows excessive smoking. The symptoms are due to the nicotine which the tobacco contains. The patient usually complains of **palpitation of the heart,** he has a **rapid irregular pulse** and is **very nervous.**

CURARA (not official)

Curara, woorara, woorali or urari, is an arrow poison which is used by the South American Indians. It is made from the bark of various trees, such as the **Strychnos toxifera.** Its active principle is an alkaloid, **curarine.** It is rarely used in practical medicine, but it is frequently used in animal experiments.

Curara paralyzes the nerve endings of all the muscles, thereby lessening their contractions. It causes a rapid weak pulse, by making the heart beat faster as a result of the paralyzed nerve endings of the Vagus nerve in the heart, which curara causes. The blood pressure is lowered, however.

It increases peristalsis and all the secretions. Curara is occasionally used to lessen the spasms of tetanus, hydrophobia, etc., but its use is dangerous on account of its weakening action on the heart. It is given in doses of gr. $\frac{1}{2}$; or curarine, the alkaloid is given in doses of gr. $\frac{1}{200}$—$\frac{1}{100}$.

CHAPTER XXIV

LOCAL ANAESTHETICS

(Depressants of the Sensory Nerve Endings)

The following drugs are used to produce insensibility to pain, or anaesthesia, only on the tissues over which they are applied. Drugs which produce such an effect, are called **local anaesthetics.**

Many of the local anaesthetics are applied directly to the surface of the skin or mucous membranes, while others are injected underneath the skin (hypodermically).

COCAINE

Coca is obtained from the dried leaves of the **Erythroxyion coca,** a shrub growing in Peru, Bolivia and other South American countries. It is now also cultivated in India, Java and Ceylon.

The coca leaves are extensively used by the natives of South America. They chew it when they have hard work to do, so as not to tire easily, and to lessen hunger.

Cocaine is an alkaloid, the active principle of coca leaves. In the Java coca, in addition to the cocaine, another alkaloid is present: **tropacocaine.** Cocaine is easily decomposed and various artificial combinations are made from it; such as cocamine, isococamine, etc.

The effects of the coca leaves are due principally to the cocaine which it contains. In practical medicine, cocaine preparations are principally used.

Appearance of the Patient

A hypodermic injection of an average dose of cocaine, or its application to the mucous membranes, usually produces insensibility to pain on the area where it is injected or on the mucous membrane on which it is applied. As soon as the

cocaine is absorbed, usually in ten or fifteen minutes, if the dose has been large, the patient becomes restless, somewhat more active, and more talkative. He usually feels happy and joyful. The patient often complains of headache, dryness of the throat; the pulse is rapid, strong and small, the breathing is rapid and deep, and the pupils are dilated.

ACTION

Local action: Applied to the skin, cocaine produces no effects, but if it is injected under the skin, or applied to a wounded surface, it relieves pain. If it is injected into a nerve, it lessens pain in the area of skin or mucous membrane from which the nerve fibers come.

On mucous membranes: Cocaine relieves pain and makes the membrane very pale and thin, by contracting its blood vessels. It also checks bleeding by contracting the blood vessels.

The insensibility to pain, or anaesthesia, produced by cocaine, lasts only for a short time: for about fifteen minutes to a half hour, depending on the strength of the solution used. As soon as the cocaine is absorbed, the anaesthesia and pallor disappear. **Cocaine produces insensibility to pain by paralyzing the nerve endings, in the skin or mucous membranes, which receive impressions of pain.**

The mucous membrane of the eye, nose, pharynx, larynx, oesophagus, stomach, urethra, bladder, vagina and rectum, are all affected in this way, if cocaine is applied directly to these mucous membranes, and it is absorbed from all of them. **In the nose,** in addition to the effects on the mucous membrane, it lessens the sense of smell, by paralyzing the nerve endings which receive impressions of smell.

Internal Action

In the mouth: Cocaine has a bitter taste for a short time, as it soon paralyzes the nerve endings in the tongue which appreciate bitter substances. It also lessens pain on the mucous membrane of the mouth, and contracts its blood vessels.

In the stomach: Cocaine acts as a local anaesthetic, and it contracts the blood vessels of the mucous membrane. It often lessens vomiting and hiccough, by paralyzing the nerve endings in the stomach, so that impulses which cause vomiting or hiccough are unable to reach the brain.

Action on the intestines: Since cocaine is so rapidly absorbed from the stomach, it affects the intestines only after absorption. It increases the peristalsis, causing more frequent movements of the bowels.

Action after Absorption

Cocaine is very rapidly absorbed into the blood from all mucous membranes, and from any region of the body where it may be injected; usually in about ten or fifteen minutes. After absorption it affects principally the circulation, the respiration, the brain, the pupil, the kidney, and slightly the muscles.

Action on the circulation: On the heart: Cocaine makes the heart beat stronger and faster. It increases the contractions of the heart muscle, and it also causes the cardio accelerator center in the medulla of the brain, to send more impulses to the heart to make it beat faster.

On the blood vessels: Cocaine makes the blood vessels narrower, by contracting the small muscle fibers in their walls, and increasing the impulses for their contraction, which are sent out from the vaso motor center in the medulla of the brain.

The total effect of cocaine on the circulation, is to make the heart beat stronger and faster, and to increase the blood pressure. **The pulse is therefore rapid, strong, but small.**

Action on the respiration: Cocaine makes the breathing faster and deeper.

Action on the brain: In large doses it increases the activity of every part of the brain. The patient is wakeful, and more susceptible to receive impressions from his surroundings, as a result of the increased activity of the sensory areas of the brain. He is usually more active, walks about and becomes

more talkative. These effects are due to the increased activity of the motor and speech areas of the brain.

The mental activities of the brain are also increased, so that all kinds of mental work such as reasoning, memory, etc., are performed better.

The emotions, especially the pleasant ones, are more active and the patient is somewhat joyful and happy.

Overdoses cause at first, greatly increased activity of the brain, and then, from exhaustion, very much lessened activity (see poisonous effects).

Action on the muscles: In large doses cocaine slightly increases the contractions of all the muscles.

Action on the pupils: It rapidly dilates the pupil, usually in about a half to one hour. It does not affect the sight for near and distant objects (accommodation). The effect wears off in about twenty-four hours.

Action on the kidney: Cocaine increases the secretion of urine, as a result of its effect on the circulation and the blood vessels of the kidneys.

Excretion

Cocaine is partly excreted by the urine, but most of it is destroyed in the body.

Poisonous Effects

Cocaine poisoning occurs in two forms: **acute cocaine poisoning,** and **cocaine habit, or chronic cocaine poisoning.**

Acute Cocaine Poisoning

Acute cocaine poisoning results from overdoses of cocaine injected hypodermically, or from its application to the mucous membranes for local anaesthesia. The symptoms are due to overactivity of the various organs of the body which cocaine principally affects, followed by exhaustion of these organs, which then produce symptoms of lessened activity or depression. The symptoms vary somewhat in different individuals. Some individuals are so susceptible to the drug that small doses may cause poisonous effects.

Symptoms

1. Usually the patient becomes **quite talkative, happy and jolly,** though he may be somewhat confused in his speech and ideas. He is quite anxious about his condition.
2. He is quite **active and moves about a great deal.**
3. **The pulse is very rapid and small, and the breathing is very rapid.**
4. The skin is pale, and covered with sweat.
5. The pupils are widely dilated.
6. Occasionally there may be vomiting.
7. Soon the **delirium** becomes more marked, the patient may seem to see objects about him, he may have muscular contractions of the hands and feet. These are soon followed by either **clonic** or **tonic convulsions,** more often clonic.
8. Finally the convulsions increase, coma and collapse develop and death ensues.
9. At times there may be no convulsions and no excitement, but sudden collapse and death. Occasionally the patient may be maniacal.

Treatment

1. Reassure the patient that his condition is not serious.
2. Apply an icebag to the head.
3. The collapse is treated with stimulants.

COCAINE HABIT

The cocaine habit is unfortunately very common, and is often induced by its beneficial effects in the nose for the relief of hay fever, catarrh, etc., as well as from its use as a substitute for morphine. It is usually taken in a liquid or powder form. The powder is usually snuffed up into the nose. Many of the cocaine habitués are also addicted to the use of other habit-forming drugs, such as morphine, etc.

Besides the gradual disturbance in the general health, the cocaine habitué develops symptoms:

1. When not under the influence of the drug.
2. After he has received his usual dose.

When not under the effects of the drug, the individual feels

depressed and is usually nervous, irritable and has twitching of the hands and arms. He is restless and cannot concentrate his mind on anything, and is unable to do his work.

When he has received his usual dose, the habitué usually brightens up, feels stronger and more energetic and his former symptoms disappear.

After continued use, however, he passes into a weakened condition of both body and mind. He becomes thin, emaciated and anaemic. He suffers from various digestive disturbances, a loss of appetite, a foul breath, a drooling of saliva from the mouth, and constipation. He is usually unable to sleep. Frequently, habitués develop ascites (fluid in the abdomen).

Finally, however, his mental and moral faculties become undermined and he eventually becomes a burden to himself, his family and friends; and an economic loss to society. He has no will power, no self control, and does not want to work. He is careless of his person and of his actions. He forgets his responsibilities, neglects his family and develops all sorts of base moral tendencies. He usually has various nervous symptoms; such as twitching of the muscles and peculiar sensations on the skin. Many votaries frequently develop hallucinations and a peculiar jumping delirium, and others become insane.

The condition is best treated in special sanitariums; and the method consists of gradually withdrawing the drug.

Uses

Cocaine is the best drug for local anaesthesia. It is readily absorbed into the blood, however, and may then cause poisonous symptoms. To avoid these symptoms, it should be remembered that the total amount of any solution of cocaine to be injected should not contain more than 0.03 gm. (gr. $\frac{1}{2}$) of cocaine hydrochloride, which is its maximum dose.

As a local anaesthetic, cocaine is given in the following ways:

1. On mucous membranes, such as the nose, throat or

larynx, it is applied with a cotton applicator. A 10 or 20% solution is used for this purpose.

Occasionally a few drops of a solution of cocaine crystals dissolved in epinephrine or adrenalin, are used. Such a solution contracts the blood vessels very markedly, prevents the absorption of the cocaine and at the same time produces a maximum anaesthetic effect.

2. **Infiltration anaesthesia.** This is a method of injecting cocaine in very weak solutions, such as a 1–1000 to ½% solution. For large areas, large quantities of weaker solutions may be used. For small areas, stronger solutions such as 4% may be used. To avoid poisonous effects, the cocaine is often injected together with epinephrine or adrenalin solutions. There are a number of preparations made up in this way. The following are the most common preparations of this kind:

Braun's Solution

This consists of

Cocaine hydrochloride	0.5–0.1
Sodium chloride	10.0–100.0
Adrenalin chloride solution	0.3–0.6

Schleich's Solution

This is made by dissolving 3 tablets, each of which contains

Cocaine hydrochloride	0.03 gm.
Morphine hydrochloride	0.008 gm.
Sodium chloride	0.06 gm.

in 100 c.c. of water.

The absorption of cocaine is often prevented by tying a tight bandage around the part to be anaesthetized, so as to contract its blood vessels.

3. Cocaine is also occasionally injected into the nerve leading from the part to be operated upon. This lessens the sensibility of the area from which the nerve fibers come.

Cocaine is also used to relieve colds in the nose (acute coryza), and to check vomiting and hiccough.

Preparations

Coca

Wine of Coca (Vinum Cocae)	4.0–16.0 c.c.	ʒi–ʒ$\frac{1}{2}$

Cocaine

Cocaine (Cocaina)	0.008–0.03 gm.	gr. $\frac{1}{8}$–$\frac{1}{2}$

This is seldom used because it does not dissolve readily in water. It does dissolve in oils.

Cocaine Hydrochloride (Cocainae Hydrochloridum)	0.008–0.03 gm.	gr. $\frac{1}{8}$–$\frac{1}{2}$

For local applications, watery solutions are used in strengths varying from $\frac{1}{2}$% to 10%. For nose and throat work 20% solutions are often used, or even the powdered cocaine dissolved in adrenalin solution may be used.

Eupthalmine (not official)

This is an artificial alkaloid which is used in 2% solutions to dilate the pupils. It does not affect the circulation.

EUCAINE

Eucaine is an artificial alkaloid which is used as a local anaesthetic. It produces local anaesthesia, like cocaine. It differs from cocaine, however, in the following ways:

1. It does not contract the blood vessels.
2. It slows and weakens the contractions of the heart, by directly affecting the heart muscle, thereby causing a slow, weak pulse, with low blood pressure.
3. It does not dilate the pupil.

Administration

For local anaesthesia in the eye, it is used in a $\frac{1}{2}$% solution. On other mucous membranes, it is applied in 2–10% solutions.

For infiltration anaesthesia, it is used in a 1–500 to 1% solution.

Eucaine is not as poisonous as cocaine, and can be boiled.

It is also often used in the form of an ointment for painful haemorrhoids.

Preparations

Eucaine is called beta eucaine, to distinguish it from alpha eucaine which was formerly used as a local anaesthetic, but because of dangerous symptoms which it produces, has now been given up.

Beta Eucaine Hydrochloride
(Beta Eucainae Hydrochloridum)

Beta Eucaine Lactate
(Beta Eucainae Lactas)

This is more soluble than the hydrochloride salt.

TROPACOCAINE

Tropacocaine is an alkaloid obtained from the leaves of the coca plant of Java. It is usually made artificially, however.

ACTION

Tropacocaine is used principally to produce local anaesthesia. Its effects are similar to those of cocaine, but they appear sooner, and last longer than those of cocaine. It does not dilate the pupil as much as cocaine.

Preparations

Tropacocaine Hydrochloride 0·03–0.06 gm. gr. $\frac{1}{2}$–1
(Tropacocainae Hydrochloridum)

This is used principally in 3–10% solutions.

HOLOCAIN

Holocain is an artificial alkaloid made from phenacetine. Its effects are similar to those of cocaine, but they appear sooner. It is also an antiseptic. It occasionally causes poisonous symptoms.

Preparations

Holocain Hydrochloride
(Holocainae Hydrochloridum)

It is principally used in a 1% solution as a local anaesthetic in the eye.

NOVOCAINE or PROCAINE

Novocaine or Procaine is an artificial alkaloid which is used as a local anaesthetic. It acts like cocaine, but it is less poisonous and its effects wear off quickly. It is usually given together with epinephrine. It is not of much value when applied on mucus membranes. The effects are only produced when it is injected hypodermically, but they are not lasting. The dissolved tablet is injected in 50 or 100 c.c. of normal salt solution. It is usually given with 0.3–0.6 c.c. of epinephrine.

Preparations

Novocaine or Procaine Tablets Each tablets contains 0.02–0.2 gm. gr. $\frac{1}{3}$–iii

There are also tablets containing novocaine and adrenalin.

Novocaine Nitrate or Procaine Nitrate 0.02–0.2 gm. gr. $\frac{1}{3}$–iii
(Novocainae Nitras)

It is usually used in a 3% solution.

ALYPIN

Alypin is an artificial alkaloid which is used as a local anaesthetic. It is supposed not to produce poisonous symptoms.

It is used principally as a local anaesthetic for eye opera-

tions, and in the urethra and bladder, before passing instruments into these organs.

In the eye it is used in 1–2% solutions. On other mucous membranes, it is used in 1–10% solutions.

Preparations

Alypin Tablets Each tablet contains 0.02–0.2 gm. grs. $\frac{1}{3}$–iii

STOVAINE

Stovaine is an artificial alkaloid which is used principally as a local anaesthetic and for spinal anaesthesia. Its effects are similar to those of cocaine with the following differences:

1. It dilates the blood vessels.
2. It is less poisonous than cocaine.

In the eye it is used in a 4% solution. On other mucous membranes, in a 5–10% solution. Hypodermically, it is used in a $\frac{1}{2}$–1% solution.

Preparations

Stovaine (in tablets) each containing 0.002 gm. gr. $\frac{1}{30}$.

ORTHOFORM

Orthoform is an artificial chemical substance formed by the combination of methyl alcohol and amidoxybenzoic acid (such a combination of an alcohol and an acid is called an ester).

It is used as a local anaesthetic like cocaine, but since it is very slowly absorbed, it produces no general effects and no poisonous symptoms. It is not used hypodermically. It is used principally to relieve pain on a wounded surface and on mucous membranes. It is often used to relieve the pain of an ulcer in the stomach.

Preparations

Orthoform New 0.5–1.0 gm. grs. viii–xv

It is often applied on wounds in the form of a dusting powder or as an ointment.

ANAESTHESIN

Anaesthesin is a chemical substance used as a local anaesthetic. It is an ester of alcohol and paramidobenzoic acid.

ACTION

The effects of anaesthesin are similar to those of cocaine. It produces local anaesthesia, but no general effects, as it does not dissolve readily and is not absorbed.

It is used internally to relieve the pain of ulcers in the stomach or of cancer of the stomach. It is also applied to relieve pain on the mucous membrane of the nose, throat, urethra, etc., and on wounded surfaces.

Preparations

Anaesthesin	0.3–0.5 gm.	grs. v–viii

It is also used in the form of a powder or an ointment.

Cycloform	0.1–0.2 gm.	grs. i–iii

It produces the same effects as anaesthesin, but is somewhat antiseptic.

Propaesin	0.25–0.5 gm.	grs. iv–viii

This acts like anaesthesin and it also contracts the mucous membrane. It is often used in 1–20% ointments.

MAGNESIUM SULPHATE

Magnesium sulphate or Epsom salt is used principally as a purgative. Applied locally however, it has a slight anaesthetic effect. When injected into the spinal canal it produces anaesthesia. The patient loses consciousness and the muscles become relaxed. Magnesium sulphate paralyzes the sensory nerve endings and the nerve terminals in the muscles. As a result sensations are no longer felt and the muscles are relaxed. When it is given hypodermically or intravenously the same effects are produced but the anaesthesia is not so evident.

Uses

Magnesium sulphate is applied locally in saturated solutions to inflammations of the skin and other skin diseases. It is also applied locally in the same solutions for rheumatic swellings of the joints, neuritis, etc. It relieves the pain by its local anaesthetic effect and the swelling by the fact that the saturated solution withdraws fluid from the tissues.

Internally it is given as a saline purgative. It is injected hypodermically in 1.0 c.c. doses of a 25% solution in tetanus, strychnine poisoning and eclampsia to lessen the convulsions. In severe cases it is given intravenously for the same purpose.

When it is given as an anaesthetic it is injected into the spinal canal. The patient lies on the back and about 5 to 10 c.c. of a 6% solution is injected into the spinal canal every few minutes until anaesthesia is produced. The method is not devoid of danger as respiratory difficulty may occur. When poisonous symptoms occur, they are treated by intravenous injections of small amounts of a 2.5% solution of calcium chloride, by artificial respiration, by intermittent inflation of the lungs through a tube into the trachea, and by giving eserine as an antidote. At the same time the spinal canal is washed out with normal salt solution or with Ringer's solution.

SPINAL ANAESTHESIA

Anaesthesia is often produced by injecting a solution of one of the local anaesthetics into the spinal canal. The solution is very slowly injected by means of a hypodermic syringe with a specially constructed needle which is inserted into the spinal canal between two of the vertebrae. This produces anaesthesia in about 15 to 20 minutes over the entire surface of the body below the level of the point of injection. The effect produced is due to the action of the drug on the nerve trunks which enter the spinal cord.

The drugs principally used for this purpose are cocaine, tropacocaine, and stovaine. Dangerous symptoms and even death may result from this method of anaesthesia.

LOCAL ANAESTHETICS USED BY DIRECT APPLICATION

ETHER

Ether is rarely used as a local anaesthetic, as its local effects last only for a very short time. It cools the skin by rapidly evaporating, and makes it insensible to pain.

ETHYL CHLORIDE

Ethyl chloride is most commonly used as a local anaesthetic. It is usually sprayed on the skin, by means of a special glass container. It freezes the area over which it is sprayed by its very rapid evaporation, thereby producing local anaesthesia. The spraying should be stopped when the skin becomes white and hard, as it may injure the tissues if continued further.

MENTHOL

Menthol is a camphor-like substance (stearoptene) obtained from the **oil of peppermint.** It produced a feeling of coolness on the skin and mucous membranes, and produces local anaesthesia. The anaesthesia is not sufficiently marked, however, to enable a surgical operation to be performed. It is used principally to relieve painful conditions of the skin.

DILUTE HYDROCYANIC ACID

(Dilute Prussic Acid)

Dilute hydrocyanic acid is a 2% solution of pure hydrocyanic or prussic acid. It is formed by the combination of hydrochloric acid and silver cyanide. It is a colorless, inflammable fluid which evaporates very easily. Hydrocyanic acid is the most poisonous substance known. The inhalation of its fumes causes instant death. Scheele, the chemist who discovered it, is said to have died in this manner.

Bitter almonds, and the kernels of the seeds of various fruits such as peaches, cherries, apricots, plums and prunes, contain a glucoside, **amygdalin** and a ferment, **emulsin.**

When the kernels of these fruits are rubbed in water, the emulsin changes the amygdalin to **prussic acid,** glucose (a sugar) and another substance. The syrup of wild cherry bark (**syrupus pruni virginianae**) also contains very small quantities of hydrocyanic acid.

1. **Applied locally to the skin or mucous membrane,** it causes numbness by paralyzing the nerve endings of the sensory nerves. It is used for this effect to allay itching and to check nausea and vomiting.

2. **Given internally,** it makes the breathing somewhat slower and shallower by lessening the impulses for breathing that are sent from the respiratory center.

Dilute hydrocyanic acid is rarely used except as an ingredient of cough mixtures to lessen the cough.

Large doses affect the protoplasm of the cells so that it is unable to combine with oxygen and therefore causes severe poisonous symptoms.

Hydrocyanic Acid Poisoning

Hydrocyanic acid poisoning usually results when the acid, or any of its salts are taken with suicidal intent; or from the inhalation of its fumes in a chemical laboratory. It is the most powerful poison known.

Symptoms

When a sufficiently large dose is taken, there is a slight convulsion and death results immediately from paralysis of the heart and respiration.

If the dose has not been very large, the following symptoms appear in a few seconds:

1. Nausea and vomiting.
2. The patient falls to the ground unconscious.
3. Bloated face and frothing at the mouth.
4. Dilated pupils.
5. Protruding eyeballs.
6. Very slow, shallow and irregular breathing. Often the expiration is prolonged, and followed by a long pause, during which the breathing seems to have stopped.

7. Very weak and irregular pulse.
8. Cyanosis.
9. Odor of acid on the breath.
10. Cold, moist skin.
11. Convulsions, with clinching of the muscles of the fingers and toes.
12. Paralysis of the muscles.

Death usually results from paralysis of the respiration, within fifteen minutes.

Treatment

Rapid, vigorous treatment is necessary in order to save the patient. Usually, however, the symptoms appear so rapidly, that death results in spite of the most active treatment. If the patient can be kept alive for about twenty minutes to a half hour, the chances of recovery are increased, as most of the drug is then excreted.

1. Wash out the stomach.
2. Give artificial respiration continuously, as long as the patient is alive. This helps to eliminate the drug through the lungs.
3. Apply cold applications to the head and spine to keep up the breathing.
4. Iron hydroxide, peroxide of hydrogen or potassium permanganate are usually given to neutralize the acid.
5. Heart and respiratory stimulants are usually given intravenously, or hypodermically.

Preparations

Dilute Hydrocyanic Acid (**Acidum Hydrocyanicum Dilutum**) 0.1–0.5 c.c. m. ii–viii

This contains 2% of hydrocyanic acid. It should always be fresh, as it decomposes very easily.

Potassium Cyanide (**Potassii Cyanidum**) 0.005–0.008 gm. gr. $\frac{1}{12}$–$\frac{1}{8}$

This is a salt formed from hydrocyanic acid. It is not as poisonous as the acid, however.

PART VII—SUBSTANCES WHICH IMPROVE NUTRITION

CHAPTER XXV

SUBSTANCES WHICH IMPROVE NUTRITION

The substances used principally to improve nutrition may be divided into two groups:

Medicinal Foods

Alteratives

Medicinal foods are preparations containing various proportions of the food principles.

Alteratives are drugs which improve the nutrition of the body, or of various organs of the body. Their mode of action is unknown. They are said to improve the condition of the blood.

MEDICINAL FOODS

The following substances are used to improve the general health and strength of the body and to build up the tissues. They are not drugs, but food substances which are very easily digested and assimilated. Many of them are predigested, and these are of particular value in patients with very poor digestion.

ACTION

All the medicinal foods improve the health and strength, by helping to build up the tissues. They are often given together with various tonics; such as iron, arsenic, phosphorus, etc. They consist largely of one or a number of the following food principles:

Proteins
Carbohydrates
Fats

Most of the preparations consist of combinations of

these food principles dissolved in alcohol, or glycerin, which serves only as a preservative.

PROTEIN PREPARATIONS

Solid Preparations

CASOID DIABETIC FLOUR

This consists of 85% of proteins obtained from milk, about 1½% of fat, and about 3% of mineral substances, while the remainder is water.

It contains no carbohydrates or starchy foods, and is used in diabetes, where starchy foods should not be given.

CIOSE

Ciose is a dry powder made from beef. It contains about 85% of proteins and has a great nutritive value. It is added to broths or soups, and is often given in wine.

SOMATOSE

Somatose is a powder which contains the proteins of meat in a very concentrated form. There are also other preparations of somatose combined with iron and milk.

SANATOGEN

Sanatogen is a powder consisting of sodium glycerophosphate combined with casein, one of the proteins of milk.

DRY PEPTONOIDS

Dry peptonoids is made by digesting beef, milk and wheat. The proteins of these foods are digested by pancreatin, and the carbohydrates, by malt diastase. It is given in doses of 8.0–16.0 c.c. (ʒii–ʒ½) in water, milk, wine, broths, soup and gruels.

Liquid Preparations

MEAT JUICES

Meat juices are of two kinds:

1. **Cold meat juices.**
2. **Warm meat juices.**

Cold Meat Juice

Cold meat juice is made by chopping up lean meat from the round of beef, into fine pieces, and expressing their juice. This contains about 6% of the meat proteins and is very nutritious.

Warm Meat Juice

Warm meat juice is made by chopping up lean meat from the round of beef, expressing the pieces, and allowing them to remain in water in a warm place for about half an hour. There are numerous meat juices on the market made by various firms, such as Liebig's, Valentine's, etc.

MEAT EXTRACTS

The meat extracts contain very little proteins, and are not very nourishing. They contain mostly extractives, such as various salts; which make the patient feel better and increase the appetite. The most common beef extracts used are extracts made by various firms, beef teas and beef essences.

LIQUID PEPTONOIDS

Liquid peptonoids contains about 5% of proteins, and about 10% of carbohydrates, mainly various sugars. It is given in doses of 15.0–30.0 c.c. (ʒ½–i).

ENEMOSE

Enemose is a sterile liquid containing about 12% of proteins from beef and wheat, and about 45% of carbohydrates, mainly from wheat.

It is used principally for rectal feeding. It usually comes in vials, the contents of one vial being dissolved in four parts of water and given by rectum.

PEPTONE

Peptone is obtained by the artificial digestion of protein substances such as meat. In large doses it is injurious to

the tissues (irritating). It is given in pastilles in doses of 5.0 gms. It is also given in suppositories for rectal feeding, or in nutrient enemas.

PANOPEPTON

Panopepton is prepared from beef and wheat by digesting them with pancreatin. The digested food is then dissolved in sherry wine. It is given in doses of 8.0–16.0 c.c. (ʒii–ʒ½).

NUTROSE

Nutrose is sodium caseinate, a salt obtained from casein, one of the proteins of milk. It is particularly valuable in chronic wasting diseases such as cancer, tuberculosis, and in pneumonia and typhoid.

PREDIGESTED LIQUID FOOD

Predigested liquid food is prepared by artificially digesting lean meat and milk with pepsin and hydrochloric acid. It contains about 10% of proteins and about 10½% of carbohydrates.

GELATINE

Gelatine is an albumin like (albuminoid) substance derived from fibrous and cartilaginous tissue. It becomes solid when cool, and liquid when heated. It is an easily digested food. It helps to coagulate the blood, and is frequently used to check bleeding from the nose, the intestines, the kidney, etc.

It may be applied locally to the bleeding area or it is given internally.

Gelatine is frequently given hypodermically or in normal salt solution by means of a hypodermoclysis. The solution must be absolutely sterile, as tetanus occasionally results from unsterile gelatine because of the tetanus bacilli contained in it.

Internally, it is given in doses of ʒi–ii, three or four times a day, or in the form of a jelly flavored, to taste better.

Preparations

Gelatine (Gelatinum)	4.0–8.0 c.c.	ʒi–ii

Glycerinated Gelatine (Gelatinum Glycerinatum)

This is gelatine impregnated with an equal amount of glycerin.

MILK FOODS

The most important medicinal foods made from milk are **kumyss** and **matzoon.**

KUMYSS

Kumyss or koumiss, is a fermented liquid prepared from mare's milk by the Tartars, who originated it. It is made from cow's milk in this country by fermenting milk with yeast. Liquid yeast is added to the milk, and the resulting fluid is then allowed to stand for about eight to ten hours in a lukewarm place.

MATZOON

Matzoon, or kefir kumyss is made by fermenting milk with a kefir fungus, a fungus obtained from **Caucasia** in Russia. It is on the market under various names such as matzoon, zoolak, etc. There are numerous other preparations of milk made by growing bulgaric bacilli, which form lactic acid in the milk. They are principally used however, for the effect of the bulgaric bacilli which they contain and they will be considered under these preparations.

There are numerous other predigested foods which are very often used in weakened conditions. The most important ones are the following:

Peptonized milk gruels
Peptonized beef tea
Peptonized oysters
Pancreatized milk toast, etc., etc.

CARBOHYDRATE PREPARATIONS

GLUCOSE, DEXTROSE OR STARCH SUGAR

Glucose or dextrose is the sugar which is present in the blood. The percentage of sugar in the blood is kept constant. It is usually about 0.08 to 0.12%. In certain diseases such as diabetes, the percentage of sugar in the blood is increased.

Glucose solutions have the same effect on the circulation as normal salt solution, but they provide energy as well. If the percentage of sugar in the blood is increased, fluid is absorbed into the blood to lower it, and if the percentage is lowered fluid is eliminated through the kidneys to raise the percentage.

When given by mouth glucose is digested by the saliva and pancreatic juice. It is then absorbed into the blood and helps to provide energy. When given intravenously in concentrated solutions it acts as a diuretic, increasing the flow of urine. Such concentrated solutions increase the sugar content of the blood. Consequently fluid is absorbed into the blood until the percentage reaches the normal again. The excess of fluid is then eliminated by the kidneys, thus increasing the flow of urine.

Uses

Glucose is used as a food in cases of malnutrition in doses of 180.0 gms. (℥ vi) daily. In dilute solutions (3–10%) it is used in shock intravenously, or by rectum to provide fluid and at the same time energy. Dilute solutions are also given for the same purpose in uraemia, acidosis and other toxaemias.

Concentrated solutions (10–50%) are given intravenously in nephritis to remove oedema which is accomplished by increasing the flow of urine. About 300 c.c. of such a solution is injected three times a day.

LEVULOSE OR FRUIT SUGAR (DIABETIN)

Levulose is a sugar which is used to sweeten the food for diabetic patients who cannot take ordinary sugars.

PREPARATIONS OF FATS

COD LIVER OIL (OLEUM MORRHUAE)

Cod liver oil is obtained from the livers of various species of codfish, especially the **Gadus morrhua.**

It consists of the various fats: olein, stearin, and palmitin, and some fatty acids. It also contains very small quantities of iodine, chlorine, bromine, phosphorus, and other substances.

The livers were formerly allowed to decompose, and the oil thus formed was then collected. By a recent method, however, the cod liver oil is obtained by forcing steam under pressure through the livers, and collecting the oil. This oil is pale in color and less nauseating than the oil formed by the old method. There are three varieties of cod liver oil: the dark, the light brown, and the pale yellow.

Cod liver oil was used for many years by the fishermen of the North Sea as a remedy for children's diseases. It is now very extensively used in medicine.

ACTION

Cod liver oil improves the general condition of the patient if given for some time. It increases the appetite, and it makes the patient stronger, stouter and healthier. Its effect depends largely upon the fats which it contains. These differ, however, from ordinary fats taken in the food, in being more easily digested, absorbed, and assimilated by the body. Cod liver oil is digested in the intestines, and is then deposited as fat in the various tissues and organs of the body, thereby building up the patient.

In overdoses, it causes nausea; occasionally, vomiting and diarrhoea.

Uses

Cod liver oil is given principally in "run down" conditions, and in chronic wasting diseases, such as tuberculosis. It is often given together with malt or creosote.

It is usually given only in winter; patients dislike it during the summer months.

Administration

The unpleasant taste and odor of cod liver oil can be disguised in the following ways:

1. By giving the oil in brandy, wine, or lemon juice, in the same way as castor oil (see castor oil).

2. By taking a little peppermint, and then putting the cod liver oil in the mouth without allowing the lips to touch it, so that the smell does not reach the nose.

3. By giving the emulsions of cod liver oil which have a more pleasant taste. They should be fresh, however, as they spoil very easily.

All preparations of cod liver oil should be given about three quarters of an hour to an hour after meals, the time when most digestion takes place.

In children, when it cannot be given by the mouth, cod liver oil may be rubbed on the skin of the chest or abdomen, before retiring, as it is readily absorbed from the skin.

Preparations

Cod Liver Oil (**Oleum Morrhuae**)	2.0–16.0 c.c.	ʒ½–iv
Emulsion of Cod Liver Oil (**Emulsum Olei Morrhuae**)	4.0–16.0 c.c.	ʒi–iv

This contains 50% of cod liver oil.

Emulsion of Cod Liver Oil with Hypophosphites (**Emulsum Olei Morrhuae cum Hypophosphitibus**)	4.0–8.0 c.c.	ʒi–ii

There are numerous preparations of cod liver oil on the market combined with preparations of phosphorus, iron, etc.

LECITHIN

Lecithin is a phosphorized fat. It consists of various salts of fatty acids such as oleic, stearic and palmitic acids combined with glycero phosphoric acid and various protein substances. It is present in large quantities in nerve tissue. It is also present in various foods, especially in egg

yolk and many vegetable foods. For medicinal purposes, it is made from egg yolk.

ACTION

Lecithin increases the nutrition of the body, though it is not nourishing in itself. It increases the number of red blood corpuscles and the haemoglobin. It is used principally as a tonic.

It is given by the mouth in doses of 0.1–0.5 gms. (grs. i½–viii) in pills, or hypodermically in doses of 1.0 c.c. (m. xv), or in 15% solutions in oil.

Preparations

Lecithin Solution 4.0 c.c. ʒi
(Containing gr. i of lecithin.)

This is a 2% solution of lecithin in glycerin and alcohol. Its action and uses are the same as those of lecithin.

Lecithol 4.0 c.c. ʒi

It is a 2% emulsion of lecithin in alcohol. It is obtained from the brains of hogs.

Glycerole of Lecithin 4.0 c.c. ʒi
(Containing gr. i of lecithin.)

Lecibrin

This is obtained from the brains of animals and is combined with nucleoproteins. It contains 33% of lecithin. It comes in small gelatine coated "pepules," each containing grs. iii which is equivalent to about gr. $\frac{1}{25}$ of phosphorus.

Neuro Lecithin 0.1–0.5 gm. gr.–i½–viii

This is a preparation of lecithin combined with small amounts of fats.

ALTERATIVES

Drugs which improve the condition of the blood, such as iron or arsenic, thereby also improve the nutrition of the body. The drugs which improve the nutrition of the nervous

system also improve the nutrition of various parts of the body. Most of these drugs, however, have other important actions and have been described under these effects.

The following drugs are occasionally used; but when given, they are used only as alteratives.

PHOSPHORUS

Phosphorus is a non-metallic element obtained from bones by the action of sulphuric acid and water. It is a semi-solid, soft, wax like, colorless or yellowish substance, which emits light in the dark, and has an odor of garlic.

Phosphorus is found in the body in many tissues, especially in nerve and bone tissue. In nerve tissue, phosphorus is present in large quantities combined with fats. These substances are called lecithins, or phosphorized fats. In the bones, phosphorus is combined with calcium, sodium, or magnesium. Phosphorus is also contained in many vegetables.

ACTION

1. The principal effect of phosphorus is to increase the growth of bone. It increases the growth of bone forming cells (osteoblasts) and makes the spongy part of the bone (the cancellous tissue) more firm and hard.

2. It slightly increases the formation of red blood cells but it does not increase the haemoglobin.

3. It is said to improve the nutrition of nerve tissue by supplying them with their necessary phosphorus. The hypophosphites and glycerophosphates are the preparations used.

Poisonous Effects

Phosphorus poisoning occurs in two forms: acute poisoning and chronic poisoning.

Acute Phosphorus Poisoning

Acute phosphorus poisoning usually results from phosphorus taken with suicidal intent. The red phosphorus is

more poisonous than the yellow. Many pastes used to destroy vermin, or match heads which contain phosphorus, are the substances usually taken.

Symptoms

The following are the characteristic symptoms which appear in about three to twelve hours. If an oily solution, or a paste is taken, they appear more rapidly; if the preparation is a solid one, they appear later.

1. Abdominal pain.
2. Nausea, vomiting and diarrhoea.
3. The vomitus and stools, as well as the urine emit light when held in the dark and have an odor of garlic.
4. Jaundice.
5. Collapse and coma.

All the symptoms of phosphorus poisoning are due to the destruction of many of the cells of some of the organs of the body. The cell substances are changed to fat globules with which the cells become filled. For example, the jaundice is due to the broken up liver cells which block up the bile ducts in the liver, and the bile is then dammed back into the blood. The vomiting and diarrhoea with the bloody vomitus and bloody stools, are due to the destruction of the cells of the mucous membrane of the stomach and intestines.

Death from phosphorus poisoning has resulted from grs. $\frac{3}{4}$–ii. It has occurred in a few hours to a few weeks.

Treatment

1. **Old common crude turpentine,** or French acid turpentine, about 2.0 c.c. ($3\frac{1}{2}$) every fifteen minutes is given as an antidote. This forms a hard solid mass with the phosphorus, and prevents its absorption.

2. Occasionally hydrogen peroxide, or potassium permanganate, may be given to oxidize the phosphorus.

3. Copper sulphate may be given to produce vomiting. It is also an antidote, and is best given in two grain doses every five minutes, until vomiting is produced. After

that gr. $\frac{1}{2}$ may be given every twenty minutes as long as ordered.

4. Wash out the stomach.

5. Give cathartics, especially salines such as hydrated magnesia.

6. Protect the mucous membrane with albuminous drinks as the white of egg, etc.

7. **Do not give oils or fats, as these hasten the absorption of the phosphorus.**

8. The collapse is treated with stimulants.

Chronic Phosphorus Poisoning

Chronic phosphorus poisoning usually occurs as a result of continually inhaling the phosphorus fumes, in individuals who work in phosphorus match factories. It occurs most frequently from the use of the yellow phosphorus, which has now mostly been given up, and the symptoms are therefore now rarely seen.

Symptoms

The symptoms usually begin with a carious tooth, or a sore gum. The gums become swollen and painful, abscesses of the jaw often form, with **destruction of pieces of the jaw bone.** Occasionally there may be **slight jaundice, anaemia, diarrhoea,** albumin in the urine, etc.

Treatment

Thorough ventilation of the factories where phosphorus is used, to get rid of the fumes, and the inhalation of the crude turpentine, usually prevents the condition.

When abscesses of the jaw form, they must be treated surgically.

Uses

Phosphorus preparations are used in the following conditions:

1. In nervous diseases, such as neurasthenia, and other similar diseases, as a nerve tonic.

2. To harden the bones in rickets, osteomalacia, etc.
3. To increase sexual activity.

Preparations

Phosphorus (Phosphorus) 0.0005–0.0012 gm. gr. $\frac{1}{120}$–$\frac{1}{50}$

Pills of Phosphorus (Pilulae Phosphori)

Each pill contains 0.0006 gm. (gr. $\frac{1}{100}$) of phosphorus.

Phosphorated Oil (Oleum Phosphori) 0.06 –0.3 c.c. m. i–v

This contains about 1% of phosphorus in almond oil and ether, and is occasionally used.

The following preparations are made from **phosphoric acid**; which is formed when phosphorus is burned.

Dilute Phosphoric Acid (Acidum Phosphoricum Dilutum) 0.3–1.0 c.c. m. v–xv

This contains 10% of the pure phosphoric acid.

From the phosphoric acid the following salts are obtained:

Precipitated Calcium Phosphate (Calcii Phosphas Praecipitatus)

This is rarely given alone, but in the form of an emulsion of cod liver oil and lactophosphate of calcium. Each ʒi contains gr. ii of calcium phosphate and ʒ½ of cod liver oil.

Zinc Phosphide (Zinci Phosphidum) 0.003–0.03 gm. gr. $\frac{1}{20}$–$\frac{1}{2}$

The following preparations are made from **hypophosphorus acid.**

Calcium Hypophosphite (Calcii Hypophosphis)	0.5–2.0 gms.	grs. viii–xxx
Iron Hypophosphite (Ferri Hypophosphis)	0.5–2.0 gms.	grs. viii–xxx
Potassium Hypophosphite (Potassii Hypophosphis)	0.5–2.0 gms.	grs. viii–xxx
Sodium Hypophosphite (Sodii Hypophosphis)	0.5–2.0 gms.	grs. viii–xxx

Syrup of Hypophosphites (Syrupus Hypophosphitum) 4.0–8.0 c.c. ʒi–ii

This contains the hypophosphite of calcium, sodium and potassium, also the tincture of lemon peel and sugar.

Compound Syrup of Hypophosphites (Syrupus Hypophosphitum Compositus) 4.0–8.0 c.c. ʒi–ii

This contains iron hypophosphite in addition to the ingredients in the syrup of hypophosphite.

The following preparations are made from **glycerophosphoric acid:**

Calcium Glycerophosphate (Calcii Gylcerophosphas) 0.2–0.6 gm. grs. iii–x

Various syrups and wines of glycerophosphates are on the market. Many of them are combined with iron. They are all good tonics.

OTHER ALTERATIVES

The Iodides and iodine preparations are frequently used to improve nutrition because of their ability to improve the action of many cells and to absorb newly forming connective tissue cells.

Calcium salts are frequently given combined with phosphorus or in the form of calcium lactate, to improve the nutrition in nervous conditions; such as tetany, epilepsy and convulsions, and in rickets. These conditions are believed to be due to a deficiency of calcium salts.

Thyroid Extract is frequently used to improve nutrition in cases where it is disturbed on account of a diminished secretion of the thyroid gland.

Mercury and gold are metals which are believed to improve nutrition.

MINOR ALTERATIVES

The following group of drugs are occasionally used principally to improve the nutrition.

SARSAPARILLA

Sarsaparilla is obtained from the roots of **Smilax officinalis,** and other varieties of smilax. It is a prickly vine obtained from Mexico, Honduras, Brazil, and other countries in the northern part of South America. Its active principles are soapy glucosides (sàponins), **sarsaponin, sarsaparilla saponin, parillin** and **smilacin,** but their quantity is not sufficient to cause a marked effect.

ACTION

Sarsaparilla is used principally to improve the nutrition of the body (alterative). It is said to increase the perspiration. In large doses it causes vomiting and diarrhoea. It was formerly used a great deal in the treatment of the third stage of syphilis, chronic rheumatism, etc. It is occasionally used as a drink.

Preparations

Fluidextract of Sarsaparilla (Fluidextractum Sarsaparillae)	2.0–4.0 c.c.	m. xxx–℥i
Compound Fluidextract of Sarsaparilla (Fluidextractum Sarsaparillae Compositus)	2.0–8.0 c.c.	m. xxx–℥ii

This contains sarsaparilla, licorice root, sassafras and mezereum.

Compound Syrup of Sarsaparilla (Syrupus Sarsaparillae Compositus)	15.0–30.0 c.c.	℥½–i

This is used as an excellent vehicle in which to give potassium iodide.

GUIAC RESIN (GUIACUM RESINA)

Guiacum is the resin of the wood of **guiacum officinale** and **guiacum sanctum,** evergreen trees of South America.

ACTION

Guiac is said to improve the nutrition of the body, to increase the secretion of sweat and the mucous membranes.

Overdoses cause vomiting and diarrhoea.

It is occasionally used in syphilis, tonsilitis, and is often given to increase the menstruation.

Preparations

Tincture of Guiac (Tinctura Guiaci)	2.0–8.0 c.c.	ʒ½–ii
Ammoniated Tincture of Guiac (Tinctura Guiaci Ammoniata)	2.0–8.0 c.c.	ʒ½–ii

Both of these preparations are best given in milk.

MEZEREUM

Mezereum is obtained from the bark of **Daphne mezereum,** a European plant. Its active principles are **daphnin, a** bitter glucoside, and an acid resin.

Uses

Mezereum is often applied on the skin in the form of the compound mustard liniment of which it is an ingredient, to produce redness. It is used internally as an alterative, in syphilis, etc.

Preparations

Fluidextract of Mezereum (Fluidextractum Mezerei)	0.6 c.c.	**m. x**

SASSAFRAS

Sassafras is obtained from the bark of the **Sassafras varifoliorum.** Its active principle is a volatile oil, the **oil of sassafras.**

ACTION

Sassafras is said to mildly improve the nutrition of the body (alterative). It also increases the sweat. It is often given together with sarsaparilla.

The oil of sassafras is used as a flavoring agent, and as a perfume.

Preparations

Oil of Sassafras (**Oleum Sassafras**)	0.06–0.3 c.c.	m. i–v

STILLINGIA

Stillingia is obtained from the **Stillingia sylvatica,** or queen's delight, an English plant.

It slightly improves the nutrition of the body. It increases all the secretions, and is said to improve the heart action.

In overdoses it causes vomiting and diarrhoea. It is occasionally used in syphilis and chronic rheumatism.

Preparations

Fluidextract of Stillingia (**Fluidextractum Stillingiae**)	2.0–4.0 c.c.	ʒ½–i

XANTHOXYLUM

Xanthoxylum is obtained from the bark of **xanthoxylum,** or prickly pear, an American tree.

It causes redness if applied locally. It is said to improve the nutrition of the body. It is often applied locally in pelvic diseases, together with tincture of capsicum.

Preparations

Fluidextract of Xanthoxylum (**Fluidextractum Xanthoxyli**)	2.0–4.0 c.c.	ʒ½–i

PART VIII—DRUGS ACTING ON THE UROGENITAL TRACT

CHAPTER XXVI

DIURETICS

(Kidney Stimulants)

Physiology of the Kidneys

The urine is secreted by the kidneys. The fluid part of the urine is formed by some of the fluid of the blood passing into the tubules of the kidneys at the glomeruli (where capillary blood vessel and tubule meet), which are situated at the cortex. In its passage along the tubules of the kidneys this fluid becomes filled with dissolved substances. These are abstracted from the blood by the direct action of the cells lining the tubules.

Classification

Diuretics are drugs which increase the flow of urine. They may be divided into the following four groups according to the method in which they increase the secretion of urine.

1. **Cell Stimulating Diuretics**
2. **Irritant Diuretics**
3. **Circulatory Diuretics**
4. **Saline Diuretics**

Cell Stimulating Diuretics are drugs which increase the flow of urine by directly making the cells of the kidney secrete more urine from the blood, without injuring the cells themselves.

Irritant Diuretics are drugs which increase the secretion of urine by irritating (injuring) the cells of the kidney and therefore making them secrete more urine from the blood.

In large doses these substances may cause inflammation of the kidney.

Circulatory Diuretics are drugs which increase the secretion of urine by improving the circulation of the kidneys so that more fresh blood is constantly being brought to them from which to form urine. This effect may result from the action of a drug on the heart, as from digitalis. It may also result from widening (dilating) the blood vessels of the kidneys so that the blood flows more freely through them and more urine is therefore able to be formed. The nitrites increase the secretion of urine in this manner.

Saline Diuretics increase the secretion of urine in the following manner: Only the salts which are absorbed are able to increase the secretion of urine. When these salts enter the blood they increase its percentage of salt and the osmotic power of the blood is thus increased. As a result, fluid is withdrawn from the tissues into the blood until the blood becomes filled with an excess of fluid. This excessive fluid then passes from the small blood vessels of the kidneys into the tubules, at the glomeruli (where blood vessels and tubules meet) thus increasing the secretion of urine.

Diuretics may also be classified according to their chemical nature; **as saline diuretics, alkaline diuretics, vegetable diuretics,** etc.

CELL STIMULATING DIURETICS

CAFFEINE

Caffeine increases the secretion of urine by directly increasing the action of the kidney cells and probably also by the improvement of the circulation.

THEOBROMA (THEOBROMINE) AND DIURETIN

Theobromine is a white powder, an alkaloid, obtained from the seeds of the **Theobroma cacao**, the chocolate tree of South America. It is very closely related, chemically, to caffeine. Its action is similar to that of caffeine.

ACTION

Local action: Theobromine has no effect when applied either to the skin or on mucous membranes.

Internal Action

In the mouth: It has a somewhat bitter taste.

In the stomach and intestines: It increases the secretions and peristalsis; often causing nausea, vomiting and frequent movements of the bowels.

Action after Absorption

Theobromine and its salts are rapidly absorbed from the stomach; usually in about a half to one hour. After absorption, they affect principally the heart, the muscles and the kidneys.

Action on the heart: It makes the heart beat stronger and faster. It also contracts the blood vessels. The pulse is therefore stronger and faster.

Action on the muscles: Theobromine increases the contractions of all the muscles.

Action on the kidneys: Theobromine and its salts are excellent diuretics. **They increase the flow of urine,** by directly increasing the activity of the kidney cells. In this way, they remove fluid from the tissues and from the abdomen, relieving oedema of the extremities and ascites.

Excretion

Theobromine and its salts are rapidly eliminated from the body mainly by the kidneys; usually in a few hours.

Poisonous Effects

Since theobromine is rapidly excreted, it very rarely produces poisonous effects. When poisonous symptoms do occur, they are the same as those produced by caffeine.

Administration

Since theobromine and its salts are rapidly eliminated,

they are best given in small doses, frequently repeated (about every two hours), when a continual effect is desired.

Preparations

All these preparations are not official.

Theobromine 0.3–1.0 gm. grs. v–xv
(Theobromina)

This preparation is apt to upset the stomach.

Theobromine Sodium Salicylate 0.3–1.0 gm. grs. v–xv
(Theobrominae Sodii Salicylas)
(Diuretin)

This preparation is very frequently given as a diuretic, because it is more readily dissolved than the others.

Theobromine Sodium Acetate 0.3–1.0 gm. grs. v–xv
(Theobrominae Sodii Acetas)
(Agurin)

Theobromine and Lithium Benzoate 0.3–1.0 gm. grs. v–xv
(Theobrominae et Lithii Benzoas)
(Urophen B)

Theobromine and Lithium Salicylate 0.3–1.0 gm. grs. v–xv
(Theobrominae et Lithii Salicylas)
(Urophen S)

THEOPHYLLIN

Theophyllin is the active principle of tea leaves. Its action is similar to that of caffeine. It is occasionally used to increase the flow of urine.

Preparations

Theophyllin Sodium Acetate 0.2–0.3 gm. grs. iii–v
(Theophyllinae Sodii Acetas)

THEOCIN

Theocin is artificial theophyllin. It is used to increase the flow of urine.

Preparations

Theocin (Theocinae)	0.2–0.3 gm.	grs. iii–v

IRRITANT DIURETICS

The following drugs are obtained from various plants and act as diuretics.

SCOPARIUS (BROOM TOPS)

Scoparius is obtained from the dried tops of the **Cytisus scoparius,** or common broom plant, which grows in Europe and the United States. Its active principles are a fluid alkaloid, **sparteine,** and a neutral substance, **scoparin.** Its diuretic action is due to the scoparin.

ACTION

The principal action of scoparius is to increase the flow of urine, but its effect is not very marked, however.

Preparations

Scoparius is given in the form of a decoction, made by boiling about 15.0 gms. (ʒ$\frac{1}{2}$) of broom tops in water; to make up 250.0 c.c. ($\frac{1}{2}$ pint). About 30.0 gms. (ʒi) of this decoction is given every 2 or 3 hours.

Sparteine, the alkaloid of scoparius, lessens the contractions of involuntary muscles and weakens the heart action. It has been described more fully under these more important effects.

JUNIPER

Juniper is obtained from the unripe, full sized berries of the **Juniper communis,** or juniper plant. Its active principle is a volatile oil, the oil of juniper, which is obtained by distilling the berries.

ACTION

Local action: Juniper produces slight redness of the skin and mucous membranes if applied locally.

Internal Action

Taken internally: It increases the secretion of the stomach and intestines. It thereby increases the appetite and aids digestion. Its principal effect, however, is to increase the flow of urine.

Poisonous Effects

Overdoses of juniper usually cause painful urination with bloody urine.

Administration

Juniper is rarely given alone. It is usually combined with cream of tartar or other alkaline diuretics.

Preparations

Oil of Juniper (Oleum Juniperi)	0.2–1.0 c.c.	m. iii–xv
Spirits of Juniper (Spiritus Juniperi)	2.0–4.0 c.c.	m. xxx–℥i

The most commonly used preparation, however, is the infusion of juniper berries. It is made by boiling an ounce of the berries in a pint of water, and is given in doses of 2.0 to 4.0 c.c. (℥½–i).

UVA URSI (BEAR BERRY)

Uva ursi is obtained from the leaves of the **Arctostaphylos uva ursi,** an evergreen shrub growing in northern Europe and the United States. Its active principles are the glucosides, **arbutin** and **methylarbutin.** It also contains an inactive glucoside ericolin, and small quantities of tannic and gallic acids.

ACTION

Because of the tannic and gallic acids which it contains, uva ursi contracts mucous membranes.

The principal action of uva ursi, however, is to increase the flow of urine, by directly increasing the activity of the kidney cells. This effect is due to the arbutin. It also acts as an antiseptic on the mucous membrane of the ureter, bladder and urethra.

Preparations

Fluidextract of Uva Ursi (**Fluidextractum Uvae Ursi**)	1.0–4.0 c.c.	m. xv–ʒi

TRITICUM

Triticum is obtained from the **Agropyron repens,** or couch grass, a grass which grows in Europe and the United States.

Triticum is said to increase the flow of urine. It is usually given in the form of a decoction; about 8.0–16.0 c.c. (ʒii–iv) in a large tumbler full of water.

Preparations

Fluidextract of Triticum (**Fluidextractum Tritici**)	2.0–8.0 c.c.	ʒ½–ii

MERCURY SALTS

The following salts of mercury are often used to increase the flow of urine.

Calomel (**Hydrargyri Chloridum Mite**)	0.015–0.15 gm.	grs. ¼–ii

As a diuretic, calomel is often given in the form of Guy's or Fothergill's pill, which contains:

Calomel
Powdered squills
Powdered digitalis, of each 0.06 gm. gr. i

Bichloride of mercury, in small doses also increases the flow of urine. In poisonous doses, it causes severe destruction of the kidney cells with lessened secretion of urine. Uraemia and death result from this condition.

Cantharides and **Turpentine Oil** are principally used locally, but they also increase the flow of urine.

CIRCULATORY DIURETICS

The following drugs increase the flow of urine by improving the circulation in the kidneys. The circulatory diuretics are of two kinds: **heart stimulants and vaso dilators.**

The heart stimulants make the heart beat stronger so that the blood is kept circulating more freely. More blood is therefore brought to the kidneys more frequently, and the secretion of urine is increased.

The vaso dilators are drugs which dilate the blood vessels of the kidneys, thus improving their circulation and increasing the secretion of urine.

Heart Stimulants Acting as Diuretics

Digitalis
Strophantus
Squills
Apocynum

For their effects see heart stimulants, page 218.

Vaso Dilators Acting as Diuretics

The following drugs increase the flow of urine by widening the blood vessels of the kidneys, thus enabling the blood to flow more freely through these organs. The cells of the kidneys are then better able to secrete urine.

The Nitrites
Pituitary Extract

THE NITRATES

The nitrates are salts formed by the combination of nitric acid and an alkali.

ACTION

The nitrates are very cooling, and increase the flow of urine; and occasionally the secretion of sweat.

Poisonous Effects

Overdoses of the nitrates often cause the following symptoms.

1. Burning pain in the throat, and in the abdomen.
2. Nausea and vomiting; the vomited matter often contains blood.
3. Diarrhoea, with bloody stools.
4. Profuse secretion of urine, or scanty urine.
5. Great muscular weakness.
6. Collapse, coma and death.

Preparations

Potassium Nitrate	0.3–2.0 gms.	grs. v–xxx
(Potassii Nitras)		
(Saltpeter)		

This preparation is the one which is commonly used. It is found in salt beds and caves in India and the United States.

Sodium Nitrate	0.3–2.0 gms.	grs. v–xxx
(Sodii Nitras)		

SPIRIT OF NITROUS ETHER

This preparation increases the flow of urine, if the skin surface is kept cool. It produces other important effects however, under which it has been considered.

Spirits of Nitrous Ether or Sweet		
Spirit of Niter	2.0–16.0 c.c.	m. xxx–℥iv
(Spiritus Aetheris Nitrosi)		

SALINE DIURETICS

The following mineral salts are frequently used to increase the flow of urine. Many of them are salts of the alkalies and are used to produce other effects.

ACTION

The saline diuretics affect principally the stomach, intestines and the kidneys. Most of them are readily absorbed.

Action in the stomach: Because of their alkaline reaction, diuretic salts neutralize the acid in the stomach.

Action in the intestines: Most of the saline diuretics also act as cathartics. They produce frequent fluid movements of the bowels. For this effect they must be given in somewhat larger doses than for a diuretic effect.

Action on the kidneys: The effect of the saline diuretics on the kidneys is to increase the flow of urine, and results from their absorption. They increase the salt concentration of the blood, and therefore its osmotic power. As a result,

fluid is withdrawn into the blood from the tissues, and the fluid content of the blood is increased. This excess of fluid is then eliminated by the kidneys, thus increasing the secretion of urine.

Administration

The saline diuretics should be given well diluted in the morning when the stomach is empty.

Preparations

Salts of Potassium

Potassium Acetate (Potassii Acetas) 0.06–0.6 gms. grs. i–x

This is a salt of potassium and acetic acid.

Potassium Bitartarate (Potassii Bitartaras) (Cream of Tartar.) 0.6–4.0 gms. grs. x–ʒi

This is a salt of potassium and tartaric acid. It is usually given in hot water, flavored with lemon juice. It is rarely given alone, usually together with the infusion of juniper.

Potassium Citrate (Potassii Citras) 0.6–1.2 gm. grs. x–xx

This is not as unpleasant to take as the other potassium salts. It increases the secretion of sweat (diaphoretic action), as well as the secretion of urine.

Solution of Potassium Citrate (Liquor Potassii Citratis) 15.0–30.0 c.c. ʒ½–i

This contains about 8% of potassium bicarbonate, and about 6% of citric acid.

Effervescent Potassium Citrate (Potassii Citras Effervescens) 2.0–4.0 c.c. ʒ½–i

This consists of potassium citrate 20%, potassium bicarbonate and sugar.

Effervescent Draught
(Not official)

This is made by adding 30.0 gms. (℥i) of potassium bicarbonate to 30.0 gms. (℥i) of lemon juice.

Other potassium salts which are occasionally used as diuretics, are potassium bicarbonate, potassium carbonate, potassium chlorate and potassium sulphate.

Salts of Sodium

The only salt of sodium that is used to increase the flow of urine, is sodium acetate.

Sodium Acetate (Sodii Acetas)	0.6–4.0 gms.	grs. x–℥i

Salts of Lithium

The salts of lithium produce the same effects as the potassium salts.

Their principal effect is to increase the flow of urine.

They are said to dissolve crystals in the urine and to prevent the formation of stones in the kidney in this way.

Preparations

Lithium Benzoate (Lithii Benzoas)	0.3–1.0 gm.	grs. v–xv
Lithium Carbonate (Lithii Carbonas)	0.3–1.0 gm.	grs. v–xv
Lithium Citrate (Lithii Citras)	0.3–1.0 gm.	grs. v–xv
Effervescent Lithium Citrate (Lithii Citras Effervescens)	4.0–8.0 gms.	℥i–ii

This contains citric acid, lithium carbonate, sodium bicarbonate and sugar.

Salts of Strontium

Strontium lactate is the only salt of strontium which increases the flow of urine.

Strontium Lactate (Strontii Lactas)	0.3–1.0 gm.	grs. v–xv

URINARY ANTISEPTICS ACTING AS DIURETICS

The following drugs act as antiseptics in the kidney, bladder and urethra. They also increase the flow of urine.

Urotropin
Methylene Blue
Buchu
Oil of Erigeron
Oil of Santal
Copaiba
Cubebs
Matico

CHAPTER XXVII

DRUGS WHICH ACT ON THE UTERUS

The drugs used principally for their effects on the uterus may be divided into the following three groups:

Ecbolics or Oxytocics (Uterine Muscle Stimulants)
Emmenagogues
Uterine Sedatives (Uterine Muscle Depressants)

Ecbolics or Oxytocics are drugs which are used to contract the uterus, and to expel its contents.

Emmenagogues are drugs which are used to increase, or to cause menstruation, when its absence is due to causes other than pregnancy.

When these drugs are used to bring about menstruation in pregnancy, they must be given in poisonous doses. Serious and even dangerous symptoms may then result, such as excessive bleeding, sepsis, etc.

OXYTOCICS

ERGOT (ERGOTA)

Ergot is a black parasitic fungus, which grows on the rye plant, **Secale cereale,** the fungus taking the place of the rye grain.

The active principles are the alkaloids: **ergotoxine, ergotine** and **tyramine.**

Appearance of the Patient

Ergot is usually given to patients for bleeding from the uterus, or to contract the uterus immediately after childbirth.

Within fifteen minutes to a half hour after a dose of a preparation of ergot is given, the patient usually complains of violent cramp-like pains in the lower part of the abdomen,

particularly in the region of the uterus. If there has been bleeding from the uterus, this is gradually lessened.

There may be nausea, and later, frequent movements of the bowels. The pulse is usually slow and strong.

ACTION

Local action: Ergot produces no effect on the skin. If it is given hypodermically, it is quite injurious to the tissues, and is apt to cause an abscess at the site of injection. **On mucous membranes:** It causes redness and swelling, with profuse secretion of mucus.

Internal Action

In the mouth: Ergot has a very unpleasant taste; it often increases the flow of saliva because of the irritation of the mucous membrane of the mouth.

In the stomach: All the preparations except the active alkaloids may cause nausea and vomiting.

In the intestines: Ordinary doses lessen peristalsis. Poisonous doses increase the secretions and peristalsis of the intestines, causing frequent bowel movements.

Action after Absorption

Ergot is rapidly absorbed into the blood through the mucous membrane of the stomach and intestines. Its effects usually appear within a half hour. After absorption it affects principally the uterus and the circulation.

Action on the uterus: This is the most important action of ergot. **Ergot increases the contractions of the uterus.** It produces wavelike contractions of the uterine muscles, which expel the contents of the uterus. It does not always start uterine contractions, but it always increases them when they are once started. By contracting the uterus, ergot contracts its blood vessels and stops uterine bleeding.

Action on the heart: Ergot makes the heart beat slower, principally as a result of its effects on the blood vessels.

Action on the blood vessels: The blood vessels are made narrower, by the contractions of the small muscle fibers in

their walls. The narrow blood vessels increase the blood pressure, and offer a greater resistance to the contractions of the heart, which are then stronger and slower. The **pulse** of ergot is therefore **slow and strong.** It is due to the ergotoxine and tyramine. The effect is similar to that of epinephrine or pituitary extract but is not as marked.

Action on secretions: The secretion of sweat and milk is lessened.

Excretion

The exact mode of excretion of ergot is unknown, but it is probably eliminated by the bowels and kidneys.

Poisonous Effects

There are two forms of ergot poisoning: acute and chronic.

Acute Ergot Poisoning

Acute ergot poisoning is very rare and usually occurs from large doses of ergot, taken to produce abortion.

Symptoms

1. Cramp-like abdominal pain.
2. Vomiting.
3. Diarrhoea.
4. Bleeding from the uterus.
5. Abortion.
6. Haemorrhages into the skin.
7. Tingling and itching of the skin, or numbness.
8. Collapse (rapid, weak pulse, cold skin, slow and shallow breathing, etc.).

There may be convulsions before death.

Treatment

1. Wash out the stomach.
2. The collapse is treated with heart stimulants, such as caffeine, strychnine, etc.

Chronic Ergot Poisoning

Chronic ergot poisoning results from eating rye bread

made from rye infected with the ergot fungus. This is more apt to occur in the rye growing during wet seasons.

Ergot poisoning is very common in Russia and other northern countries, where a good deal of rye bread is eaten. In the mediaeval age plagues of ergot poisoning were quite common.

There are two forms of chronic ergot poisoning:

1. **The Gangrenous form**
2. **The Spasmodic form**

In some epidemics the gangrenous, and in others the spasmodic form predominates.

Gangrenous Form

This is due to the persistent contractions of many of the blood vessels. As a result, various parts of the body, such as the fingers, the toes, the ears or the tip of the nose may be deprived of their blood supply, and the part affected then dies or becomes gangrenous.

Symptoms

The limbs are first affected. **The fingers and toes become cold,** they lose their sensation, and become blue in color. **Soon they become hard and shriveled up and fall off,** without causing pain. Sometimes the gangrene spreads up over the extremities, and the forearm or leg may become gangrenous. Occasionally areas of gangrene may form in the internal organs. **Ulcers in the stomach and intestines** may occur, because various areas of these organs are deprived of their circulation. **Ulcers of the cornea** of the eye may also result from the contraction of some of the small blood vessels leading to the cornea.

Nervous or Spasmodic Form

The symptoms of this form are believed to be due to spasms of the muscles in some of the small blood vessels of the brain. The contraction of some of these vessels obliterates the circulation in certain areas of the brain, thus causing the various symptoms. Some of the symptoms remain permanently.

Symptoms

1. Weakness.
2. Drowsiness.
3. Headache.
4. Dizziness.
5. Itching, and a feeling as if something were creeping over the limbs (formication).
6. Temporary or partial blindness.
7. Painful cramps in the limbs.
8. Clonic convulsions, followed by epileptiform convulsions. The mind remains clear after the attacks, but often the patient becomes insane.

The treatment varies with the symptoms.

Uses

Ergot is used to contract the uterus, and to prevent or check uterine bleeding. It should always be given when the **uterus is empty.**

In labor cases it should always be given **after the third stage of labor;** that is, after the placenta is expelled. If given before the placenta is entirely expelled, the contractions of the uterus may cause pieces of the placenta to remain in the uterus, which may become infected and cause sepsis.

Ergot is frequently given to check bleeding from the lungs, from an ulcer of the stomach, from an ulcer of the intestines in typhoid fever, etc. The bleeding is checked by the contractions of the bleeding vessels.

Ergotoxine and tyramine are used to increase the blood pressure.

Administration

Ergot has a very unpleasant taste which should always be disguised. It is best given after meals.

When given hypodermically, it should be injected deep into the muscles, and the part should be massaged very thoroughly afterwards.

Preparations

Fluidextract of Ergot (Fluidextractum Ergotae)	2.0–8.0 c.c.	ʒ½–ii

Wine of Ergot 10.0–20.0 c.c. ʒii½–v
(Vinum Ergotae)

This contains about 20% of ergot.

Ergot preparations should always be fresh, as they change very readily and become inactive if kept for any length of time.

There are a number of preparations of ergot on the market which are suitable for hypodermic use. There are other preparations which are not so nauseating and are more reliable than the usual preparations. Most of them are not official.

New and Non-official Preparations

Ergotoxine phosphate 0.0006–0.0012 gm. gr. $\frac{1}{100}$–$\frac{1}{50}$

This is one of the active principles of ergot and is given hypodermically.

Ergotinine Citrate 0.0006–0.0012 gm. gr. $\frac{1}{100}$–$\frac{1}{50}$
(Ergotininae Citras)

This is an alkaloid which is changed in the body to ergotoxine.

Tyramine 0.03 gm. gr. $\frac{1}{2}$

This is one of the active alkaloids of ergot; it is used to contract the uterus and to increase the blood pressure.

Purified Extract of Ergot: 0.2–0.5 gm. grs. iii–viii
Extractum Ergotae Purificatum
(Bonjean's Ergotin)

This is a purified extract of ergot about ten times as strong as ergot itself. It is often given hypodermically.

Ergotole 0.3–2.0 c.c. m. v–xxx

This is an excellent preparation made from specially cultivated Spanish ergot. It is about 2½ times as strong as the fluidextract. It is suitable for hypodermic use.

Ernutin 2.0–4.0 c.c. m. xxx–ʒi

This is a reliable preparation of ergot, which has a pleas-

ant taste. It is given hypodermically in doses of 0.3–0.6 c.c. (m. v–x).

Cornutol	hypodermically	0.6–2.0 c.c.	m. x–xxx
	by mouth	0.6–4.0 c.c.	m. x–ʒi

(Liquid Extractum Ergotae)

HYDRASTIS (GOLDEN SEAL)

Hydrastis is obtained from the roots and underground stems of **Hydrastis canadensis**, golden seal or yellow root. It is a small shrub growing in the United States. Its active principles are the alkaloids, **hydrastine** and **berberine.**

Appearance of the Patient

After giving hydrastis, or any of its alkaloids, the patient usually has a better appetite, and the bowels move more freely. If there has been bleeding from the uterus, this is gradually checked. The pulse is slow and strong.

ACTION

Local action: On the skin, hydrastis has no effect. **Applied to mucous membranes:** It increases their secretions.

Internal Action

In the mouth: It has a bitter taste and increases the flow of saliva.

In the stomach: It increases the appetite, and aids digestion by increasing the secretion of gastric juice, and the peristalsis of the muscle wall of the stomach.

In the intestines: It increases the secretion and peristalsis, causing frequent movements of the bowels.

Action after Absorption

Hydrastis is slowly absorbed into the blood, mainly through the intestinal mucous membrane. After absorption, it affects principally the circulation, the involuntary muscles, especially the muscle fibers in the walls of the blood vessels, and the uterus.

Action on the Circulation

On the heart: hydrastis makes the heart beat slower, by increasing the impulses for slowing the heart, sent from the medulla of the brain. It also slightly increases the contraction of the heart muscle.

On the blood vessels: It makes the blood vessels narrower by contracting the muscle fibers in their walls. This increases the blood pressure and helps to make the heart beat stronger.

The total effect on the circulation is to make the heart beat slower and stronger, which causes a **slow and strong pulse.**

Action on the uterus: Hydrastis contracts the uterus. It checks bleeding from the uterus by contracting the uterine blood vessels as well as the uterus itself.

Action on the involuntary muscles: It contracts all the involuntary muscles, such as those of the intestines, of the iris, as well as those of the blood vessels.

Hydrastis is said to increase the secretion of bile.

Excretion

Hydrastis and its alkaloids are mainly eliminated from the body by the kidneys. It is excreted very slowly, much slower than it is absorbed, so that cumulative symptoms often result from continual administration.

Hydrastine

The slow, strong pulse, the contractions of the blood vessels, the contractions of the uterus, and other involuntary muscles, are due to the action of **hydrastine.**

Berberine

The increased appetite, the increased secretions of the stomach and intestines are due to berberine; which is a simple bitter. This alkaloid is often found in many other plants used as simple bitters.

Poisonous Effects

Poisoning from hydrastis or from its alkaloids is extremely rare. In the few cases that have occurred the symptoms were the following:

1. Vomiting.
2. Headache.
3. Dizziness.
4. Difficult breathing.
5. Slow, weak, irregular pulse.
6. Convulsions.
7. Collapse; and death from failure of breathing.

Uses

Hydrastis is used for the following effects:

1. As a bitter, to increase the appetite and aid digestion by increasing the secretion of the gastric juice.
2. To check uterine bleeding.
3. For constipation, to make the stools more fluid in character.

Preparations

Fluidextract of Hydrastis (Fluidextractum Hydrastis)	1.0–4.0 c.c.	m. xv–℥i
Tincture of Hydrastis (Tinctura Hydrastis)	1.0–4.0 c.c.	m. xv–℥i
Glycerite of Hydrastis (Glyceritum Hydrastis)	1.0–4.0 c.c.	m. xv–℥i

This is used principally to relieve inflammations of the mucous membranes.

Hydrastine is rarely used, but an artificial alkaloid made from it, hydrastinine, is very frequently used.

HYDRASTININE

Hydrastinine is an artificial alkaloid made by oxidizing hydrastine. It produces the same effect as hydrastis, but it is more efficient and more lasting.

ACTION

Hydrastinine markedly contracts the uterus and all the small blood vessels. As a result of the latter effect it increases the blood pressure. It is used to check uterine bleeding.

Preparations

Hydrastinine Hydrochloride 0.01–0.03 gm. gr. $\frac{1}{6}$–$\frac{1}{2}$
(Hydrastininae Hydrochloridum)

This is given hypodermically in solution, and by the mouth in pills or tablets.

STYPTICIN (COTARNINE HYDROCHLORIDE)

(not official)

Cotarnine hydrochloride, or stypticin, is an artificial alkaloid, made by oxidizing narcotine, one of the alkaloids of opium.

ACTION

It contracts the blood vessels, and the uterus.

It is principally used to check bleeding from the uterus. It is also used to check bleeding from other parts of the body, such as the lungs, the stomach, or the intestines, by contracting the blood vessels of these organs. Gauze soaked in cotarnine is very frequently used by dentists to check bleeding.

Preparations

Cotarnine Hydrochloride (Stypticin) 0.015–0.1 gm. grs. $\frac{1}{4}$–ii
(Cotarninae Hydrochloridum)

It is given hypodermically in solution, or by the mouth in pills or tablets.

Cotarnine Phthalate (Styptol)
(Cotarninae Phthalas)

Hypodermically 0.2 gm. (grs. iii) dissolved in 2.0 c.c. (m. xxx) of water.

By mouth, 3 to 5 tablets a day. Each tablet contains gr. of the drug.

PITUITARY EXTRACT (not official)

Pituitary extract or pituitrin, is an extract of a small gland, situated at the base of the brain. It causes marked contractions of the uterus in about half an hour after it is given. The contractions usually last for several hours.

It is used to check bleeding from the uterus and to cause uterine contractions after labor.

This substance produces other more important effects. (See page 239.)

It should be given hypodermically.

Preparations

Pituitary Extract	1.0 c.c.	m. xv
In small glass vials.		
Pituitrin	1.0 c.c.	m. xv
In small glass vials, for hypodermic use.		

QUININE

Quinine is used to increase uterine contractions. It has other more important actions, however, under which it will be described.

EMMENAGOGUES

Emmenagogues are drugs which increase menstruation.

Many drugs, such as iron, arsenic, or strychnine, which improve the general condition of the patient, will increase menstruation.

Many cathartics, such as castor oil or aloes, when given in large doses, and all the drastic purgatives, will increase menstruation.

Counterirritants, such as mustard or cantharides, when taken internally, will also increase menstruation.

The substances used principally to increase menstruation, however, all contain volatile oils which are their active principles. These volatile oils are responsible for the following severe poisonous symptoms that result from large doses.

Poisonous Symptoms of Volatile Oil Emmenagogues

1. Abdominal pain.
2. Nausea and vomiting.
3. Profuse diarrhoea with bloody stools.
4. Abortion.
5. Scanty, bloody urine.
6. Convulsions.
7. Unconsciousness.
8. Collapse.

Volatile Oil Emmenagogues and Their Preparations

OIL OF PENNYROYAL (OLEUM HEDEOMAE)

The oil of pennyroyal is a volatile oil obtained from the leaves and tops of **Hedeoma pulegioides,** or the pennyroyal plant.

It is used to expel gas from the intestine and to increase the menstrual flow. It is not a very active drug, but it is a common household remedy.

Preparations

Oil of Pennyroyal (Oleum Hedeomae)	0.06–0.3 c.c.	m. i–v

APIOL

Apiol is an oily liquid (a stearoptene), obtained from the root of ordinary garden parsley or **Apium petrosinellum.** It resembles camphor and is often called parsley camphor. Its active principle is said to be a substance called **apioline.**

Apiol is used to increase the menstrual flow, especially when the scanty menstruation is due to anaemia and when the menstruation is painful.

Preparations

Apiol	0.2–0.6 gm.	grs. iii–x
Apioline	0.2–0.5 gm.	grs. iii–viii

Apiol is given in capsules; most of which are imported from France. Each capsule contains 0.25 gm. (grs. iv). There are a number of preparations of apiol combined with ergot and other substances.

GOSSYPIUM (COTTON ROOT BARK)

Gossypium cortex is the dried bark of the ordinary cotton plant, **Gossypium herbaceum.**

It has been used by the Southern negroes to produce abortion. It is occasionally used as a substitute for ergot, to contract the uterus and to check uterine bleeding.

Preparations

Gossypii Cortex	2.0 gms.	grs. xxx

UTERINE SEDATIVES

The following drugs are used principally to lessen contractions of the uterus, and to relieve painful menstruation.

VIBURNUM PRUNIFOLIORUM (BLACK HAW)

Viburnum is obtained from the root of the **Viburnum prunifoliorum** or black haw, a small American plant.

ACTION

It lessens the contractions of involuntary muscles, especially the muscles of the uterus. It soothes uterine contractions, and is said to check colic and cramps.

It is used principally to relieve painful or excessive menstruation, and to relieve the pains of ovarian disease.

Preparations

Fluidextract of Viburnum Prunifoliorum (Fluidextractum Viburni Prunifolii)	2.0–16.0 c.c.	ʒ ½–iv

VIBURNUM OPULUS (CRAMP ROOT)

Viburnum opulus, or cramp root, is obtained from the bark of the **Viburnum opulus,** a small American tree.

It acts like viburnum prunifoliorum, but is less soothing to the uterus and is said to relieve colic and cramp-like pains, more than viburnum prunifoliorum does.

Preparations

Fluidextract of Viburnum Opulus (Fluidextractum Viburni Opuli)	2.0–16.0 c.c.	ʒ ½–iv.

There are a number of drugs which lessen, or soothe uterine contractions, but which have other more important effects. The most common of these are the following:

Morphine
Atropine
Antipyretic group
(Acetanilid)
(Antipyrine)
(Phenacetine)
(Pryamidon)

PART IX—SPECIFICS

CHAPTER XXVIII

SPECIFICS

Specifics are drugs which are principally used to cure a particular disease. This effect is produced by destroying or neutralizing the causative agent of that disease. The best example of this action is the effect of quinine in malaria. The organism which causes this disease is destroyed by the quinine.

Many of the specifics relieve the symptoms of a particular disease, though the mode of action may be unknown. An example of such an action is the effect of the salicylates in rheumatism.

CINCHONA AND QUININE

Quinine is a white powder, an alkaloid, the active principle of **cinchona,** or peruvian bark. This is the bark of the cinchona tree, which grows in the Andes or other mountainous districts on the western coast of South America. The tree has been cultivated successfully, however, in other parts of the world, as in India and Java. There are two kinds of cinchona: **Cinchona rubra,** or red bark, and **Cinchona calisaya,** or yellow bark. They both produce the same effects, but the yellow bark contains more quinine.

Cinchona is named in honor of the Countess of Cinchon, a Spanish countess who was cured in 1638, of a disease that was then known as the ague, but what we now know to be malaria. The drug had just been introduced in medicine at that time. It was brought to Spain by the Spanish explorers who learned of its use from the South American Indians. Besides **quinine,** the active alkaloid, cinchona contains the alkaloids, **quinidine, conquinine, cinchonine,** and

cinchonidine. They resemble quinine in their effects; which are weaker, however.

Appearance of the Patient

When quinine is given to a patient suffering from malaria, it prevents the chills, fever and sweats, which are characteristic of that disease.

After administration of a single average dose of quinine, the patient usually complains of a bitter taste in the mouth, he feels brighter, and the pulse is perhaps somewhat more rapid and stronger. If there is temperature, it is lowered several degrees.

If the quinine is given for some time, the patient feels better, he has a better appetite, his bowels move more regularly, he feels brighter and stronger and is more active. The pulse is somewhat stronger and more rapid, the breathing is deeper and somewhat more rapid.

ACTION

Quinine affects all living tissues (protoplasm). It increases their activities at first, but soon lessens them. All the effects of quinine are due to this action. Quinine has no selective action on any particular organ or tissue.

It destroys various living organisms such as amoebae, bacteria, etc.

Local action: Applied to the skin or mucous membranes, quinine causes slight redness and acts as an antiseptic. It is not generally used as an antiseptic, because it is too expensive. It is said to increase the growth of hair and therefore forms an ingredient of many hair tonics.

Internal Action

In the mouth: Because of its very bitter taste quinine increases the appetite and the secretion of saliva.

In the stomach: It lessens the action of pepsin, thus retarding the digestion of protein food. In large doses, it occasionally causes nausea and vomiting.

In the intestines: It retards the action of the trypsin of

the pancreatic juice, and increases the secretions and peristalsis, often causing frequent movements of the bowels.

Action after Absorption

Quinine is slowly absorbed into the blood, principally from the stomach. The presence of acid in the stomach aids the absorption. It begins to be absorbed in about 15 minutes, but the absorption is not complete until about four or five hours. When it enters the blood, it acts as a specific for malaria, and it slightly affects the nutrition and the action of all the tissues and organs.

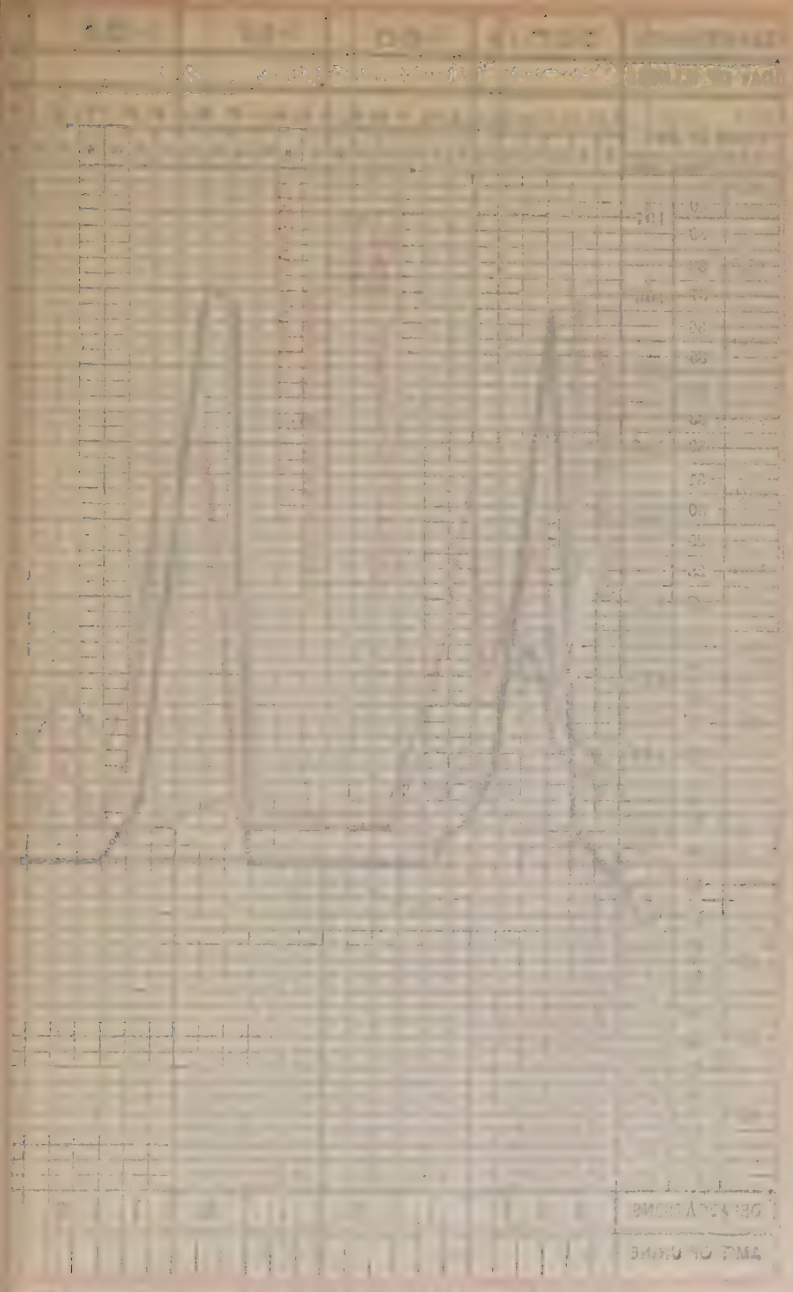
Specific Action in Malaria

Malaria

Malaria is a disease caused by a unicellular organism, a protozoan called the **Plasmodium malariae.** This organism is injected into the blood of the patient, when an individual is bitten by a species of mosquito, the **anopheles.** The organisms then enter the red blood corpuscles, where they grow and develop into other similar organisms in 48 or 72 hours, depending on the type of organism. At the end of this time, the red blood corpuscles burst, the newly formed malarial parasites and poisonous substances, together with the haemoglobin of the red blood corpuscles, are thrown into the blood.

As a result of the sudden destruction of a large number of red blood corpuscles, and the liberation of poisonous substances, the patient has a chill. The violent muscular contractions which are thus produced, elevate the temperature several degrees, and since this temperature is excessive, it is followed by sweating, which gradually reduces it to normal again.

These chills, fever and sweats occur every other day, if the organism which causes these symptoms is the **tertian type,** or the one which develops in 48 hours. They occur every third day, if the organism is the **quartan** type or the one which develops in 72 hours. In some cases, the chills, fever and sweats occur every day. This is due to the fact that the



patient is infected with two types of tertian organisms, each one developing every 48 hours, but on alternate days. The attacks always occur regularly at about the same time during the day.

Effect of Quinine in Malaria

If a patient suffering from malaria is given quinine, **the quinine enters the blood and destroys the plasmodiae.** The chills, fever and sweats are then prevented, and the disease is cured. The use of quinine must be continued for some time, however, even after the symptoms have disappeared; until all the plasmodiae in the blood are destroyed, and the patient is free from attacks.

Effect on nutrition and metabolism: Quinine increases the nutrition of the tissues and organs of the body, by preventing the nitrogenous, or protein food from being used up (combining with oxygen). These foods help to build up the patient and conserve the strength. In this way **quinine acts as a tonic,** slightly improving the action of all the tissues and organs of the body and making the patient feel better and stronger.

Action on the blood: Besides its destructive action on malarial parasites, quinine prevents the red blood corpuscles from taking up oxygen as readily as before. It also lessens their number and checks the movements of the white blood corpuscles.

Action on the circulation: The pulse is made somewhat stronger and faster, because the contractions of the heart and blood vessels are increased. Large doses occasionally cause a slow and weak pulse because of the slightly weakened contractions of the heart.

Action on the nervous system: Quinine lessens nervousness and neuralgic pains.

Action on the senses of sight and hearing: Large doses of quinine very frequently cause **ringing in the ears, and dimness of vision.**

Action on the uterus: Quinine increases the contractions of the uterus during labor; it occasionally causes abortion.

Effect on temperature: The temperature is lowered be-

cause oxidation of the nitrogenous or protein substances of the tissues is lessened, and less heat is produced.

Excretion

Quinine is eliminated from the body by the urine, mostly in about 6 to 8 hours.

Idiosyncrasies

Many individuals are especially susceptible to quinine, even small doses causing poisonous effects. In some individuals, the following unusual symptoms occur, even from very small doses:

1. Eruptions on the skin, such as areas of redness resembling the scarlet fever rash, hives or urticaria, and occasionally small blisters. (Herpes.)
2. Occasionally scanty urine, accompanied by pain; often the urine is tinged with blood or haemoglobin.
3. Slow and weak pulse, and a feeling of weakness.

Poisonous Effects

Since quinine is very frequently given in large doses for malaria, poisonous effects are not uncommon. These effects result from continued use of quinine, or from very large doses taken to produce abortion. While the symptoms which result may be alarming, they are rarely, if ever, fatal.

Symptoms

The first and most characteristic symptom of quinine poisoning is:

Ringing in the ears, or roaring sounds in the ears. Often the patient may become temporarily deaf. Rarely the deafness remains permanent.

2. **Dimness of vision,** especially for colors.
3. Temporary blindness or "color blindness." The blindness is occasionally permanent.
4. Nausea and vomiting.
5. Slow, weak pulse.
6. Muscular weakness.
7. Collapse.

Treatment

The symptoms usually subside when the drug is stopped. If they do not disappear, they are usually relieved by bromides. If the pulse is weak, caffeine, given hypodermically, or a hot coffee enema, usually improves it.

Uses

Quinine is used principally in the following conditions:

1. **As a specific in malaria.**
2. As a bitter, to increase the appetite; and as a tonic to improve nutrition.
3. To reduce fever.
4. To destroy the amoebae, unicellular organisms which cause amoebic dysentery, a chronic disease of the intestines. In these cases quinine is usually given by irrigations into the colon or large intestine.

Administration

In malaria, quinine is usually given in one single large dose of 1.0 gm. (grs. xv) about 4 hours before the time when the chill should occur. It may also be given in divided doses, so that the last dose is given **about the time of the expected chill.** By the time the quinine enters the blood, the parasities are very young and are readily destroyed. It may also be given in divided doses when the temperature is going down, **after the chill.** The administration of quinine should be kept up, however, for about a week after the attack is over, to prevent a recurrence of the symptoms.

1. Quinine is best given in solution after meals, since the presence of acid in the stomach aids the absorption. The addition of a drop of dilute sulphuric acid to the fluid will also aid the absorption.

Quinine is frequently given in the form of powders or pills. The pills are usually not very efficient unless they are fresh. Old quinine pills may pass out in the stools without being absorbed. The addition of a few drops of dilute sulphuric acid usually makes the quinine preparation more soluble.

2. On account of its unpleasant, bitter taste, quinine should be given in sherry wine, in cachets or capsules, or some food, such as olive oil, may be given afterwards.

3. For its bitter effect it should be given before meals in fluid form, undiluted.

Preparations

Cinchona

Fluidextract of Cinchona (Fluidextractum Cinchonae)	1.0–4.0 c.c.	m. xv–℥i
Tincture of Cinchona (Tinctura Cinchonae)	4.0–16.0 c.c.	℥ i–iv
Compound Tincture of Cinchona (Tinctura Cinchonae Composita)	2.0–4.0 c.c.	℥ ½–i

The cinchona preparations are used principally as bitters to increase the appetite. For malaria and as a tonic, quinine preparations are preferable.

Quinine

Quinine (Quinina)	0.3–1.0 gm.	grs. v–xv
Quinine Bisulphate (Quininae Bisulphas)	0.3–1.0 gm.	grs. v–xv

This is the most common preparation used, as it is the most soluble one.

Quinine Sulphate (Quininae Sulphas)	0.3–1.0 gm.	grs. v–xv
Quinine Hydrobromide (Quininae Hydrobromidum)	0.3–1.0 gm.	grs. v–xv
Quinine Hydrochloride (Quininae Hydrochloridum)	0.3–1.0 gm.	grs. v–xv

Other Alkaloids of Cinchona

Cinchonine Sulphate (Cinchoninae Sulphas)	0.5–1.3 gm.	grs. viii–xx
Cinchonidine Sulphate (Cinchonidinae Sulphas)	0.5–1.3 gm.	grs. viii–xx

Compound Preparations

Iron and Quinine Citrate 0.3–0.6 gm. grs. v–x
(Ferri et Quininae Citras)

Syrup of Iron, Quinine and Strychnine Phosphate 4.0 c.c. ʒ i
(Syrupus Ferri, Quininae et Strychninae Phosphatum)

Elixir of Iron, Quinine and Strychnine Phosphate 4.0 c.c. ʒ i
(Elixir Ferri, Quininae et Strychninae Phosphatum)

Warburg's Tincture

This is a dark brown liquid which is used extensively in India, in the treatment of malaria. It contains a large number of ingredients besides quinine, such as aloes, rhubarb, gentian, camphor, etc.

New and Non-official Preparations

Quinine and Urea Hydrochloride 0.3–1.0 gm. grs. v–xv
(Quininae et Ureae Hydrochloridum)

This preparation is suitable for hypodermic use. It is also used as a local anaesthetic injected hypodermically or applied to mucous membranes.

Quinine Tannate 0.6–2.0 gms. grs. x–xxx
(Quininae Tannas)

This preparation is slowly absorbed, and has no bitter taste.

Aristochin 0.3–1.0 gm. grs. v–xv

This is a chemical derivative of quinine. It is not so apt to cause poisonous symptoms.

Euquinine 0.3–1.0 gm. grs. v–xv
(Quininae Aethylcarbonas)

This is a chemical derivative of quinine, which is tasteless.

Chinaphenin 0.3–0.6 gm. grs. v–x

This is a compound of quinine and phenacetine. It combines the quinine action with the anodyne effect of phenacetine. It is tasteless and is not apt to cause poisonous symptoms.

Quinine Lygosinate
(Quininae Lygosinas)

This is a chemical derivative of **quinine.** It is used as an antiseptic dusting powder, or in solution to check bleeding.

Saloquinine	0.5–2.0 gms.	grs. viii–xxx

This combines the action of quinine with salicylic acid.

Saloquinine Salicylate	1.0 gm.	grs. xv

This acts like saloquinine.

ETHYLHYDROCUPREINE (OPTOCHIN)

Optochin or Ethylhydrocupreine is a substance obtained from the Cuprea bark, the bark of a Chinese plant. It is also made from hydroquinine, a substance made from quinine. Ethylhydrocupreine acts like quinine. It has, however, a specific destructive action on pneumococci, the bacteria which cause pneumonia. It has therefore been used in recent years as a specific for pneumonia.

It is applied locally in 1% solutions to local infections caused by the pneumococci such as certain forms of corneal ulcers in the eye.

It is given in pneumonia as a specific. The treatment is begun by giving 0.5 gm. (grs. viii) as an initial dose, followed by 0.15 gm. (gr. ii$\frac{1}{2}$) every 3 hours until 1.5 gm. (grs. xxiii) has been given in twenty four hours. The best results are obtained when the drug is given early in the disease as otherwise the pneumococci become resistant to it. It is also given hypodermically in solution or in oil.

Poisonous Effects

Ethylhydrocupreine is particularly apt to cause poisonous symptoms which are those of quinine poisoning. It is especially apt to cause eye symptoms however, even blindness.

Preparations

Ethylhydrocupreine hydrochloride
Ethylhydrocupreinae hydrochloridum
(Optochin)

PHLORIDZIN (not official)

Phloridzin is a glucoside obtained from the roots of the apple, pear, cherry, and other trees.

It is occasionally used to destroy malarial parasites. It forms sugar in the urine and increases its secretion. Because of its irritating effect on the kidneys, it is rarely used, except to test the action of the kidneys.

Preparations

Phloridizin (**Phloridizinum**)	0.3–0.6 gm.	grs. v–x

Methylene blue is also occasionally used as a specific for malaria.

MERCURY (HYDRARGYRUM)

Mercury or quicksilver is a silver-colored liquid metal which evaporates very easily. Many of its salts are used in medicine.

Appearance of the Patient

A few hours after giving an average dose of a preparation of mercury, the patient usually has several movements of the bowels and more urine is passed. The stools are soft, colored with bile, and accompanied by a little griping. Occasionally the flow of saliva is also slightly increased.

If small doses of mercury preparations are given continuously for weeks or longer, to a patient suffering from the first or second stage of syphilis, the symptoms, such as the original ulcer or chancre, the rash on the body, the mucous patches in the mouth, and the swelling of the glands, all gradually disappear.

ACTION

The salts of mercury combine with the proteins and albumins of all living matter, forming an albuminate of mercury. It is therefore injurious to, and may even destroy living cells. In this way, it checks the growth of bacteria (antiseptic action), and other living organisms and parasites (antiparasiticide).

Local action: Applied to the skin, mercury preparations are excellent antiseptics. If a strong solution is used, or even a weak solution continuously, redness, pain and itching of the skin will result. If a strong solution is kept in contact with the skin for a long time, inflammation and even destruction of the skin may result.

Mucous membranes are shrunk and contracted by the action of mercury preparations (astringent action).

Internal Action

In the mouth: Mercury preparations have a distinct metallic taste, and contract the mucous membranes.

In the stomach: They slightly increase the secretions, occasionally causing nausea.

In the intestines: Mercury preparations increase the secretions and peristalsis, **causing frequent soft stools stained with bile.** They also act as intestinal antiseptics. The large quantity of bile in the stools which results from preparations such as calomel, is due to the antiseptic action, which prevents the decomposition of the bile, and to the increased peristalsis of the bile ducts which accelerates its flow. Mercury preparations do not increase the secretion of bile, as was formerly supposed. The preparations of mercury, such as calomel, which are not readily absorbed, are the best ones to use as cathartics.

Action with Absorption

Mercury salts are readily absorbed into the blood from all the mucous membranes, from the lungs, and even by the skin. When given by mouth, they are absorbed in 1 to 2 hours. After absorption, they affect principally the intestines, the kidneys, some of the secretions, the nutrition of the tissues, and if given steadily, they act as a specific for the first and second stages of syphilis.

Action on the kidneys: Mercury salts increase the flow of urine.

Action on the secretory glands: All the secretions, especially the saliva and pancreatic juice, **are increased.**

Action on nutrition: Small doses of mercury preparations, if given for some time, increase the nutrition of the tissues, and the body weight. (Alterative action.)

Specific Action in Syphilis

Syphilis

Syphilis is a chronic infectious disease, caused by the **Spirochaeta pallida,** a spiral shaped organism. The infection begins with the formation of a hard ulcer, or **chancre,** usually on the genital organs. This is known as the first stage of the disease. It is followed in about six weeks, by an eruption all over the body (**roseola**), whitish patches in the mouth (**mucous patches**), and **swelling of all the lymph glands** throughout the body. This is known as the second stage of the disease. Some time later, in several months or years, or at any time during the patient's lifetime, he may suffer from various diseases, which result from the formation of **gummata.** Gummata are areas of round cells which readily decompose, forming a thick fluid in the center. Any organ of the body may be affected in this way, producing many and varied symptoms. The occurrence of these late symptoms is known as the third stage of the disease.

Parents infected with syphilis may transmit the disease to their children. The children may be born dead, or they may suffer, if they live, at any time during their childhood from various symptoms which are characteristic of the third stage of the disease in the acquired form.

Effect of Mercury

Mercury preparations, if given steadily to a patient suffering from the first or second stage of syphilis, **usually relieve all the symptoms in a very short time.** The rash and the mucous patches soon disappear, the glands become smaller; until they, too, finally disappear. This curative action of mercury in syphilis is probably due to the destruction of the spirochaeta pallida, the organism which causes the disease.

Excretion

Mercury preparations are excreted mainly by the kidneys and the intestines, and also slightly, by all the excretions, such as the saliva, milk, bile, gastric juice, etc. They are very slowly eliminated from the body, usually in one or two days. Some of the mercury often remains in the body for a long time afterwards, and may then be gradually excreted for some time.

Poisonous Effects

Mercury poisoning occurs in two forms: acute poisoning and chronic poisoning.

Acute Mercury Poisoning

Acute mercury poisoning usually results from swallowing bichloride of mercury in tablet form or in solution either by accident or suicidal intent. Frequently the use of strong bichloride of mercury douches causes poisoning symptoms.

Symptoms

1. Metallic taste in the mouth, and burning pain in the throat.
2. Cramp-like, abdominal pains.
3. Nausea and vomiting; the vomited matter contains bile and later blood.
4. Diarrhoea with bloody stools.
5. Scanty urine which may contain albumin blood.
6. Collapse, as a result of the profuse vomiting and diarrhoea; rapid, weak, irregular pulse, the face is pinched and anxious, the skin is cold and moist, the breathing slow and shallow.
7. Convulsions and coma may occur before death.

Usually the patient lives several days or weeks; he develops a very severe acute nephritis characterized by scanty, bloody urine, which contains albumin. He finally develops uraemia with convulsions, coma and death.

Death from mercury poisoning usually occurs in one to seven days.

If death does not occur recovery takes place very gradually, the symptoms of the nephritis persist and the patient develops salivation, soreness of the gums or gangrenous ulcers in the mouth, throat, jaws, palate or cheeks which last for a long time.

When the poisoning results from vaginal douches the nausea and vomiting are absent, but the patient suffers principally from diarrhoea with serous or bloody stools which last for weeks, with soreness of the gums and ulceration of the jaw gradually developing.

Treatment

1. The antidote for mercury poisoning is white of egg, milk or flour. These substances contain albumins, which combine with the mercury, forming an albuminate of mercury, and thus prevent the poisonous effects. About one egg should be given for every 4 grains of bichloride of mercury or other preparation taken.

2. Opium or morphine is given to check the diarrhoea, and to keep the patient quiet.

3. The collapse is treated with heart stimulants such as caffeine, atropine, strychnine, etc.

"Mercurialism"

Mercurialism is a very common condition which results from prolonged use of mercury preparations. Syphilitic patients can often take large doses of mercury without developing any poisonous effects.

Symptoms

The following are the symptoms of excessive mercury action:

1. **Profuse flow of saliva,** and a metallic taste in the mouth. This is soon followed by:

2. **Soreness and bleeding of the gums,** later ulcerations of the gums, mouth or throat, loosening of the teeth, and even destruction of the jaw-bone. The breath has a very foul odor from the destroyed tissue.

3. **Diarrhoea,** often with bloody stools.
4. Anaemia.
5. Loss of weight.
6. Scanty urine.
7. Paralysis of the hands or feet with "drop-wrists" or "drop-feet."

Treatment

1. Stop the administration of mercury.
2. The soreness of the gums is best relieved by a potassium chlorate mouth wash or a tannic acid mouth wash. The gums are often painted with tincture of myrrh.
3. The diarrhoea is best checked by opium.

Uses

Mercury preparations are used principally:
1. As a specific for the first and second stages of syphilis.
2. Many of the preparations are excellent antiseptics.
3. Some of the preparations are excellent purgatives.
4. Mercury is said to have a very beneficial effect in relieving acute infections of the serous membranes, such as pleurisy or peritonitis. It also reduces enlargements of lymph glands.

Administration

1. For absorption from the skin, mercury is applied by **"rubbings"** or **inunctions** in the form of an ointment. The ointment is thoroughly rubbed on the skin for six days, every day on a different region of the body; thus, one day on the arms, another day on the forearms, the thighs, the legs, the back, etc. On the seventh day the patient is given a bath to remove the ointment from the skin; and then the course is begun again.

In giving mercury inunctions, the nurse should protect her hands with leather gloves, as otherwise she herself may absorb the drug, and develop poisonous effects.

Mercury is also given for absorption by the skin, in the form of vapor. The patient sits in a closed cabinet over a

lamp containing burning calomel. The fumes thus generated are absorbed by the skin. Some mercury preparations are frequently given by mouth.

An excellent method of giving mercury is by deep injections into the muscles. The preparation is usually injected into the muscles of the buttocks, which are thus rubbed very thoroughly to hasten the absorption.

Preparations

Bichloride of Mercury 0.0012–0.006 gm. gr. $\frac{1}{50}$–$\frac{1}{10}$
Corrosive Sublimate
(Hydrargyri Chloridum Corrosivum)

This is rarely used internally. It is principally used as a local antiseptic in 1–1000 to 1–5000 solutions. It usually comes in tablets of 0.5 gm. (grs. vii$\frac{1}{2}$) each, which are dissolved in water to make up the required strength. Corrosive sublimate cannot be used to disinfect instruments, as it stains them black.

Mild Mercurous Chloride 0.006–0.3 gm. gr. $\frac{1}{10}$–v
Calomel
(Hydrargyri Chloridum Mite)

This preparation is used principally as a cathartic. It is given in tablets or as a dry powder on the tongue.

Blue Mass 0.1–0.5 gm. grs. ii–viii
(Massa Hydrargyri)

This is mercury rubbed with glycerin, honey, licorice, althaea, etc., and contains $33\frac{1}{3}\%$ of mercury. It is used principally as a cathartic, in the form of pills; each pill containing 0.2–0.3 gm. (grs. iii–v) of blue mass.

Mercury with Chalk 0.12–0.5 gm. grs. ii–viii
Gray Powder
(Hydrargyrum cum Creta)

This is a gray powder made like blue mass, but it contains chalk in addition to the other ingredients. It is used as a mild cathartic.

Yellow Iodide of Mercury 0.008–0.06 gm. gr. $\frac{1}{8}$–i
Protoiodide of Mercury
(Hydrargyri Iodidum Flavum)

Red Iodide of Mercury 0.0012–0.006 gm. gr. $\frac{1}{50}$–$\frac{1}{10}$
Biniodide of Mercury
(Hydrargyri Iodidum Rubrum)

Solution of Arsenic and Mercuric Iodides 0.06–0.3 c.c. m. i–v
(Liquor Arseni et Hydrargyri Iodidi)
(Donovan's Solution)

This contains 1% each of arsenic iodide and the red mercuric iodide.

For Local Use

Mercurial Ointment
Blue Ointment
(Unguentum Hydrargyri)

This is made by thoroughly rubbing together mercury, oleate of mercury, lard and suet. It is used principally for inunctions.

Ointment of Yellow Mercuric Oxide
(Unguentum Hydrargyri Oxidi Flavi)

This contains 10% of yellow oxide of mercury.

Ointment of Red Mercuric Oxide
(Unguentum Hydrargyri Oxidi Rubri)

This contains 10% of red oxide of mercury.

Ointment of Ammoniated Mercury
(Unguentum Hydrargyri Ammoniati)

This contains 10% of ammoniated mercury.

Ointment of Mercuric Nitrate
(Unguentum Hydrargyri Nitratis)
Citrine Ointment

This contains 7% of mercuric nitrate.

New and Non-official Preparations

Black Wash
(Lotio Hydrargyri Nigra)

This consists of 4.0 gms. (ʒ i) of calomel to 500 c.c. (1 pt.) of lime water. It is used principally as an external application.

Yellow Wash
(Lotio Hydrargyri Flava)

This consists of corrosive sublimate 2.0 gms. ($ʒ\frac{1}{2}$) to 500 c.c. (1 pt.) of lime water. It is used principally as a local application.

Mercuric Salicylate 0.003–0.008 gm. gr. $\frac{1}{20}$–$\frac{1}{8}$
(Hydrargyri Salicylas)

This preparation is now frequently used, especially for intramuscular injections. For these injections, a 10% solution in water or liquid paraffin is used, of which 0.6 c.c. (m. x) is injected deep into the gluteal muscles every fourth day.

Mercuric Succinimide 0.01–0.015 gm. gr. $\frac{1}{6}$–$\frac{1}{4}$
(Hydrargyri Succinimidum)

This is used principally for intramuscular injections. A $2\frac{1}{2}$% solution is used, of which 0.5–1.0 c.c. (m. viii–xv) are injected daily.

It also comes in hypodermic tablets, each containing 0.006–0.003 (gr. $\frac{1}{10}$–$\frac{1}{20}$).

Mercurol 0.03–0.12 gm. grs. $\frac{1}{2}$-ii
(Hydrargyri Nucleinas)

This is said to have a special value as an antiseptic and specific for syphilis.

Mergal one capsule 0.015 gm. gr. $\frac{1}{4}$

This is a mixture of mercuric cholate and albumin tannate put up in capsules. Each capsule contains 0.05 gm. (gr. $\frac{3}{4}$) of mercuric cholate.

Mercuric Benzoate 0.015–0.03 gm. gr. $\frac{1}{4}$–$\frac{1}{2}$
(Hydrargyri Benzoas)

This has been used principally as a specific for syphilis and is given hypodermically.

Calomelol
Colloidal Calomel
(Hydrargyri Chloridum Mite Colloidale)

Calomelol is a preparation of calomel combined with albuminoids, and is said to act more efficiently, not to gripe as much, and to be less poisonous than calomel.

THE IODIDES

The iodides are salts formed by the action of an alkali, such as sodium, potassium or ammonium, on hydriodic acid, an acid formed from iodine; which is a non-metallic element, obtained from sea-weeds.

Appearance of the Patient

After a single dose of one of the iodide salts is given, except for its slightly metallic salty taste, a slight burning pain in the stomach, and perhaps some slight nausea for a few minutes, there are no appreciable effects.

If the iodides are given continuously for some time, however, the secretions are all increased, the pulse is somewhat faster and softer, the patient passes more urine and feels much better.

Prolonged administration of the iodides to a patient suffering from any manifestation of **syphilis,** especially any symptoms of **the third stage,** causes a gradual disappearance of these symptoms, and in a very short time the patient feels entirely well again. For example, if the patient has a syphilitic ulcer in any region of the body, the ulcer gradually heals. A syphilitic paralysis when treated with an iodide preparation, soon disappears, and the patient can move the paralyzed extremity perfectly well again.

ACTION

Local action. The iodides produce no local effect when applied on the skin or mucous membranes, but they are rapidly absorbed into the blood from all mucous membranes.

Internal Action

In the mouth: The iodides have a characteristic salty metallic taste.

In the stomach: They slightly increase the secretions, and occasionally cause nausea, and slight discomfort. The intestines are not usually affected by the iodides.

Action after Absorption

The iodides are very rapidly absorbed into the blood; from the stomach, intestines, and from all the mucous membranes usually in about five minutes. After absorption, they act principally as a specific for syphilis. They also affect the secretions, the thyroid gland, newly formed tissues, the nutrition, and slightly the kidneys.

Specific Action in Syphilis

The most striking effect of the iodides is noticed in patients suffering from syphilis, especially from the symptoms of the third stage. These symptoms are the result of the formation of areas of round cells (gummata) in various parts of the body as a result of the presence in the blood of the spirochaeta pallida. These newly formed areas of cells very soon become fluid and areas of various tissues and organs of the body are thus destroyed, producing various symptoms.

Very soon after the treatment with the iodides is begun in such cases, the patient feels better, the particular manifestation of syphilis from which he may be suffering, begins to improve, until finally he is entirely well again. For example, if the patient is suffering from a syphilitic ulcer in any part of the body, this ulcer heals very rapidly after treatment with iodides.

A syphilitic paralysis due to the formation of a gumma in the brain or spinal cord, when treated with iodides soon disappears. The affected extremities regain their motion and the patient soon feels entirely well again. In a similar manner, a syphilitic condition of any organ of the body is cured.

The iodides cure the third stage of syphilis, by causing the absorption of newly formed areas of round cells, or gummata, which cause the various symptoms. They also probably destroy the spirochaetae which cause the disease.

Action on the secretions: The iodides increase the secretions of all the mucous membranes and the secretory glands. The mucus from the nose and bronchi is increased, and becomes more fluid in character. The secretion of saliva, of milk, and the secretions of the other glands are also slightly increased.

Action on the Thyroid Gland: Iodine is a normal constituent of the thyroid gland and is necessary for the formation of its secretion. By providing this gland with more iodine its secretions are increased. As a result, it makes the pulse somewhat more rapid, and lowers the blood pressure. The absorption of newly formed connective tissue cells may also be due to the action on the thyroid gland. These cells become more fluid in character and are more readily absorbed.

Action on nutrition: They increase the nutrition of the tissues and hasten the excretion of waste products. It is probably due to the increased secretion of the thyroid gland.

Effect on newly formed connective tissues: The iodides increase the absorption of newly formed connective tissue. They are used to absorb old scar tissue in any organ of the body. They are frequently used for this effect in arteriosclerosis (hardening of the arteries), cirrhosis of the liver, etc.

Newly formed connective tissue cells are small round cells which resemble the round cells found in gummata. These cells may therefore be affected by the iodides in the same way as the gummata or round cell formations of the third stage of syphilis or as a result of the increased secretion of the thyroid gland.

Accumulations of serum in the chest (pleurisy with effusion) or in other parts of the body, are more rapidly absorbed when iodides are given.

Action on the circulation: Iodides do not usually affect the pulse. They occasionally lower the blood pressure when it is high and make the pulse somewhat more rapid. The effect is probably due to the increase in the secretion of the thyroid gland.

Action on the kidneys: The iodides slightly increase the flow of urine.

Excretion

The iodides are eliminated from the body by the urine, mainly as iodides, usually within twenty-four hours. In the body the iodine is separated from the iodide salts, which is then excreted in all the secretions of the secretory glands and mucous membranes. The mucus of the nose and the bronchi, the saliva, the milk, the hair, all contain iodine.

Idiosyncrasies

In some individuals small doses of the iodides often cause poisonous effects.

Poisonous Effects

The iodides do not cause acute poisoning. Since they are excreted more slowly than they are absorbed, after prolonged administration, chronic poisoning or **iodism** frequently results from the accumulation of some of the drug in the body. These cumulative symptoms occasionally occur in some individuals from very small doses.

The symptoms of iodism are due to the excretion of the iodine by the various mucous membranes, and they are not so apt to occur in syphilitic patients.

Cumulative Symptoms or "Iodism"

The first symptom of excessive iodide action is:

Profuse secretion of mucus from the nose (coryza) and sneezing.

These are soon followed by:

2. Red, swollen eyelids with excessive flow of tears.
3. **Frontal headache.**
4. Cough, with profuse expectoration of mucus.
5. Increased flow of saliva.
6. Sore throat and difficulty in swallowing.
7. **Skin eruptions,** such as areas of redness, or small pustules on the face, back, shoulders or thigh (acne). Occasionally eczema occurs.
8. The pulse is often rapid and a slight rise in temperature may occur.
9. Nausea and diarrhoea occasionally occur.

10. Weakness, loss of weight, and pains in the joints occasionally result from continued use.

Treatment

When the iodides are stopped, the symptoms usually disappear.

Uses

The iodides are used principally:

As a specific for the third stage of syphilis. In syphilis, the treatment must be continued for about three years; even if the patient has no symptoms, to eradicate all the poison from the body.

2. They are also frequently used to absorb connective tissue in various chronic diseases characterized by the formation of connective tissue in various organs and tissues of the body. For example, in **arteriosclerosis** (thickening of the blood vessels by the formation of connective tissue in their walls), **cirrhosis of the liver,** or the formation of connective tissue in the liver, **chronic nephritis** or the formation of connective tissue in the kidneys, etc.

3. To increase the absorption of inflammatory swellings of the glands and other tissues, and to absorb fluids in the chest.

4. To increase the secretions of the mucous membranes, such as those of the bronchi, the nose, etc.

Administration

The iodides are best given after meals, in milk, wine, aromatic spirits of ammonia, or the compound spirits of sarsaparilla, or cinnamon water, to disguise the unpleasant taste. It is occasionally given in pills or capsules.

Preparations

Potassium Iodide 0.3–1.0 gm. grs. v–xv
(**Potassii Iodidum**) In syphilis it may be given up to 4.0 gms. (ʒi)

This is the most efficient and most commonly used preparation. It often comes in 50% or saturated (100%) solutions.

Sodium Iodide (Sodii Iodidum) 0.12–1.3 gm. grs. ii–xx

Ammonium Iodide (Ammonii Iodidum) 0.12–1.0 gm. grs. ii–xv

Strontium Iodide (Strontii Iodidum) 0.3–1.0 gm. grs. v–xv

Dilute Hydriodic Acid (Acidum Hydriodicum Dilutum) 0.3–0.6 c.c. m. v–x

This contains 10% of hydriodic acid.

Syrup of Hydriodic Acid (Syrupus Acidi Hydriodici) 2.0–8.0 c.c. $\mathfrak{Z}\frac{1}{2}$–ii

This contains 1% of hydriodic acid.

For Local Use

Potassium Iodide Ointment (Unguentum Potassii Iodidi)

New and Non-official Preparations

Sajodin 1.0–3.0 gms. grs. xv–xlv

This acts like potassium iodide, but is said not to produce the symptoms of iodism.

Ferro Sajodin 1–2 tablets

This contains 5% of iron and 24% of iodine. It comes in tablets, each containing 0.5 gm. (grs. viii) of ferro sajodin.

Iodo Casein 0.3–1.3 gm. grs. v–xx

It is digested in the intestine where it is rapidly absorbed, then acting like the iodides. It does not disturb digestion as much as the other iodides.

Iodalbin 0.3–0.6 gm. grs. v–x

This is a compound of iodine and albumin from blood. It is absorbed from the intestines, and it then acts like the other iodides.

Iodipin 0.2–0.6 gm. grs. iii–x

This is a compound of iodine and sesame oil. It acts like the other iodides, but its effects are more lasting, and they

are said not to cause iodism. It is given hypodermically. It usually comes in 10 or 25% solutions or in capsules, each containing 2.0 gms. (grs. xxx).

Iothion

This acts like the iodides or iodine, and is readily absorbed from the skin. It is applied in a 25 to 50% ointment like mercury ointment.

SALVARSAN OR ARSPHENAMINE

Salvarsan, arsphenamine, arsenobenzol, or "606" is a complex organic arsenic salt. It is a yellow powder which comes in a sealed glass tube together with nitrogen gas, since it is readily changed by the oxygen of the air.

ACTION

Salvarsan is a specific for all stages of syphilis. It combines with, and destroys the Spirochaeta pallida, the organism which causes the disease. In a few weeks after the administration of the remedy, there is a remarkable and prompt disappearance of all the symptoms of the disease, such as the initial sore, the rash, the mucous patches and the other manifestations. The patient is not considered cured, however, until the examination of his blood shows that he is free from the disease. The administration of the remedy is therefore repeated at weekly intervals.

The symptoms of the third stage of syphilis frequently return as long as twenty years after the original infection and since salvarsan has only been in use for a few years, it is impossible to state at the present time whether the cure is permanent or not. Salvarsan should therefore be used in conjunction with, or followed by, the usual two year course of treatment with mercury and iodides.

Salvarsan has also been used with success in the treatment of malaria and other infectious diseases resulting from the circulation in the blood of parasitic organisms, such as those of relapsing fever, frambesia, etc.

Neosalvarsan is not as efficient as salvarsan, therefore it must be given in larger doses, but it is easier to administer.

Idiosyncrasies

1. Symptoms of arsenic poisoning may result.

2. The rash may temporarily become more intense, there may be a rise in temperature, headache and ringing in the ears (Hexheimer's reaction).

Administration

Salvarsan is usually given by direct injection into the veins.

The ampoule containing the salvarsan is wiped off with alcohol and the neck is filed and broken off. The powder is then put into a sterile glass stoppered bottle. Sterile distilled water is now added and the powder is dissolved by shaking the bottle. A 15% Sodium hydroxide solution is then added drop by drop, until the fluid becomes cloudy. A few drops more are added and the cloudiness clears up. It is usually necessary to add about 3 or 4 drops of the Sodium hydroxide solution for every 0.1 gm. of salvarsan. The mixture is then diluted by adding about 30 c.c. of sterile water for each 0.1 gm. of salvarsan used. The salvarsan solution is now ready for administration and it is poured into a glass apparatus and allowed to run into the vein very slowly through a rubber tube and intravenous needle. Some physicians dissolve the salvarsan in much smaller quantities of fluid. It is also given by deep injections into the muscles.

2. Neosalvarsan is dissolved in sterile, distilled water, about 25 c.c. being used for every 0.1 gm. of the drug.

It is given like salvarsan, by injection into the veins (intravenously), or into the muscles (intramuscularly).

Neosalvarsan is only half as strong as salvarsan. It does not have to be neutralized with an alkali.

Swift Ellis Method

This method consists of injecting into the spinal canal, the serum of the patient after salvarsan has been injected into the veins. Such prepared serum is given in cases of syphilis of the brain and spinal cord. A dose of salvarsan is injected into the vein and an hour later 40 c.c. of blood is withdrawn

from the vein. This is allowed to clot and is then placed on ice for twenty-four hours. When the blood has clotted entirely the serum is removed with a pipette. A 40% solution is then made of this serum by adding 12 c.c. of the serum to 18 c.c. of normal salt solution. The solution is now heated for about half an hour to a temperature of about 50° C. and is then injected into the spinal canal after removing the same quantity of fluid from the spinal canal.

Preparations

Arsphenamine or Salvarsan	0.3–0.6 gm.	grs. v–x
Arsphenolamine hydrochloride		
" 606 "		

This contains about 31% of arsenic.

Neolsalvarsan	0.6–0.9 gm.	grs. x–xiv

Salvarsan is now made by different firms under the following names:

Arsaminol
Arsenobenzol
Diarsenol
Neoarsphenamine
Arsphenolamine S (Neosalvarsan)

SALICYLIC ACID AND THE SALICYLATES

Salicylic acid is a white crystalline powder which is made chemically by the action of sodium hydroxide (caustic soda) and carbonic acid, on carbolic acid.

The **salicylates** are salts formed by the combination of an alkali, with salicylic acid. For example, sodium salicylate is formed when salicylic acid is combined with sodium. Various other salts are made in a similar way, by the combination of an organic chemical substance, such as methyl alcohol, with salicylic acid. **Methyl salicylate** is formed in this way.

Many salicylates are found in various plants. For example, methyl salicylate is found in the **oil of wintergreen,** or **oleum gaultheriae,** and in the **oil of sweet birch, oleum betulae.**

There are many new artificial preparations made chemically from salicylic acid or its salts, some of which, such as aspirin, are extensively used.

Appearance of the Patient

About 15 minutes after an average dose of salicylic acid, or one of the salicylates is given, the patient complains of a slight burning pain in the pit of the stomach, and possibly of a slight feeling of fullness in the head. Soon he sweats profusely, and the temperature is lowered 1 or 2 degrees, particularly if there is fever. The pulse may be somewhat faster and stronger, unless a large dose has been given, when it may be slightly slower and weaker. The breathing is usually somewhat more rapid, and the patient passes more urine.

If the patient is suffering from acute articular rheumatism, the pains and swellings around the joints are gradually relieved.

ACTION

Local action: Salicylic acid and the salicylates are antiseptics. They also soften the epidermis or hard layer of the skin when directly applied. **On mucous membranes,** they cause redness and increased secretions (irritation).

Internal Action

In the mouth: They have a peculiar salty sour taste.

In the stomach: Salicylic acid and the salicylates increase the secretions. If given when the stomach is empty, they are apt to cause burning pain in the stomach, occasionally nausea, and possibly vomiting.

In the intestines: They have an antiseptic action, checking the growth of bacteria.

Action after Absorption

Salicylic acid and the salicylates are rapidly absorbed from the stomach and intestines, usually in about 15 minutes. After absorption, they affect the temperature, the sweat

glands, the circulation, the respiration and the kidneys. They affect especially acute articular rheumatism.

Specific Action in Rheumatism

Salicylic acid and the salicylates are used principally as specifics for acute articular rheumatism.

Acute articular rheumatism is a disease characterized by pain, redness and swelling of the various joints of the body, associated with high temperature. The disease begins in one joint, and then affects many of the others. Its cause is unknown, though it is probably an infectious disease.

Effect of Salicylates

When any of the salicylates are given regularly for some time, to a patient suffering from acute articular rheumatism, the pains become lessened in a few days, the redness and swelling of the joints are diminished, the temperature subsides, and the patient soon gets well.

The mode of action is probably due to the excretion of salicylic acid into the joints and thus affecting the causative agent of the disease. Many cases are improved by some preparations of the salicylates more than by others. Other cases are not improved at all by any of them. Chronic rheumatism does not respond so readily to treatment with the salicylates.

Effect on temperature: The salicylates reduce the temperature several degrees in fevers, because of the increased elimination of heat which results from the profuse sweating and dilated blood vessels of the skin. The temperature begins to go down in fifteen minutes, and stays down for about six hours. The normal temperature is not affected, however.

Action on the secretions: The salicylates increase the secretion of sweat especially. About fifteen minutes to a half hour after a dose of one of the salicylates is given, the patient is usually covered with profuse perspiration. The salicylates are said to also increase the flow of bile.

Action on the circulation: The salicylates usually make the pulse somewhat faster and stronger at first, by increasing

the contractions of the heart muscle and contracting the blood vessels.

With larger doses, the contractions of the heart muscle are soon weakened and the pulse becomes slower and weaker.

The blood vessels of the skin are usually dilated, so that the skin is flushed.

Action on the respiration: The breathing becomes slightly more rapid; occasionally the patient is somewhat short of breath (dyspnoeic).

Action on the kidneys: The salicylates increase the secretion of urine. They act as antiseptics along the urinary organs, and make the urine more acid in reaction; due to increasing the amount of uric acid. The urine occasionally contains albumin.

Excretion

The salicylates are eliminated from the body as **salicyluric acid,** mainly by the urine; usually in several hours. Some of the drug is also excreted in the perspiration, milk and bile.

Poisonous Effects

Large doses of salicylates often cause quite alarming symptoms, especially if used for a long time, but they are rarely fatal. The symptoms resemble those of quinine poisoning.

Symptoms

Overdoses of salicylates cause the following symptoms:

1. **Buzzing and noises in the ears,** and a feeling of fullness in the head.
2. **Deafness.**
3. Dimness of vision.
4. **Profuse perspiration.**
5. Feeling of warmth all over the body.
6. **Occasionally nausea and vomiting.**

In severe cases besides these symptoms there are usually:

7. Dyspnoea, rapid, irregular, deep and labored breathing.
8. Collapse (slow, weak pulse, subnormal temperature, cold, moist skin, etc.).
9. Unconsciousness.

10. Occasionally the patient becomes delirious or even maniacal, and he often seems to see various objects about him (hallucinations of sight) or he seems to hear voices (hallucinations of hearing).

Death has rarely resulted from salicylate poisoning.

Treatment

1. If the drug is stopped, the symptoms usually disappear in a few days or a week.

2. Caffeine, strychnine, or other heart stimulants are usually given, if the pulse is weak.

Administration

Salicylic acid or the salicylates, are best given in capsules, tablets or in a small quantity of milk or syrup, about an hour or two after meals.

They are best given with sodium bicarbonate to overcome the pain in the stomach, or the nausea and vomiting which may result from the rapid formation of salicylic acid in the stomach.

Preparations

Salicylic Acid (Acidum Salicylicum)	0.3–2.0 gms.	grs. v–xxx

This is more readily dissolved in hot water or in a solution of boric acid or borax.

Sodium Salicylate (Sodii Salicylas)	0.3–2.0 gms.	grs. v–xxx

This is more soluble than the salicylic acid and is not so apt to upset the stomach.

Lithium Salicylate (Lithii Salicylas)	0.3–2.0 gms.	grs. v–xxx
Ammonium Salicylate (Ammonii Salicylas)	0.3– gm.	grs. v
Strontium Salicylate (Strontii Salicylas)	1.0– gm.	grs. xv
Oil of Wintergreen (Oleum Gaultheriae)	0.3–1.0 c.c.	m. v–xv

This is a volatile oil obtained by distilling **Gaultheria procumbens** or wintergreen. It contains 90% of methyl salicylate and is given in an emulsion or in capsules. It acts like the salicylates, but it occasionally causes nausea and vomiting.

Oil of Sweet Birch (Oleum Betulae) 0.3–1.0 c.c. m. v–xv

This is made by distilling the bark of **Betula lenta** or birch bark.

Methyl Salicylate (Methylis Salicylas) 0.3–1.0 gm. grs. v–xv

This is artificial oil of wintergreen. It is contained in oil of wintergreen and oil of sweet birch.

Salicin (Salicinum) 0.3–2.0 gms. grs. v–xxx

Salicin is a glucoside obtained from the bark of various species of willow and poplar trees. It is changed to salicylic acid in the body and it then produces the same effects.

It has a very bitter taste and is not as reliable in its action as the other preparations.

Salol (Phenylis Salicylas) 0.3–2.0 gms. grs. v–xxx

Salol is a tasteless powder which is decomposed by the steapsin of the pancreatic juice in the intestine, into salicylic and carbolic acids. The salicylic acid is absorbed into the blood from the intestines, and it then produces the same effects as the salicylates. It is frequently used as an intestinal and urinary antiseptic. Symptoms of carbolic acid poisoning occasionally result from the carbolic acid which is formed in the intestines.

For Local Use

"Borosal" Solution
(Thiersch Solution)

This is a solution made by dissolving a Thiersch powder in 1000 c.c. or a quart of water.

Each Thiersch powder contains:

Boric Acid	15.0–30.0 gms.	ʒss–i
Salicylic Acid	2.0– 4.0 gms.	ʒss–i

Thiersch solution is used as an antiseptic dressing, and is particularly valuable to soften the skin.

Salicylic Acid Ointments:

These usually contain from 2 to 20% of salicylic acid and are principally used to soften and remove corns. Many corn salves and plasters consist principally of salicylic acid.

New and Non-official Preparations

Aspirin 0.3–1.0 gm. grs. v–xv
(Acidum Acetylsalicylicum)

This is a compound made chemically from salicylic acid. It is absorbed in the intestines and then acts like salicylic acid, but because it is very slowly absorbed, its effects are more lasting. It is not so apt to cause poisonous effects.

Novaspirin 0.3–1.0 gm. grs. v–xv
(Methylene Citrylsalicylic Acid)

It acts like aspirin but is said not to upset the stomach.

Diaspirin 1.0 gm. grs. xv
Succinyl Disalicylic Acid

Ethyl Salicylate 0.3–0.6 c.c. m. v–x
(Aethylis Salicylas)
(Sal Ethyl)

This is similar to methyl salicylate, and is said not to cause poisonous symptoms.

Mesotan or Ericin

This is an oily fluid made from salicylic acid (methyl oxymethyl salicylate). It acts like the oil of wintergreen and is applied to the skin in an equal part of olive oil.

Salophen 0.3–1.0 gm. grs. v–xv

This resembles salol in its action. It is changed in the intestines to **salicylic acid,** and **acetylparamidophenol,** which is not poisonous. It is therefore safer than salol.

Saloquinine 0.5–2.0 gms. grs. viii–xxx

This is a compound of quinine and salicylic acid; quinine salicylate. It combines the action of both.

Saloquinine Salicylate 1.0 gm. grs. xv

This acts like saloquinine.

Spirosal
Monoglycol Salicylate

This is absorbed from the skin and acts like salicylic acid which it forms in the body. It is applied on the skin in solutions. The drug is dissolved in three parts of alcohol or in eight parts of olive oil.

Betol or Naphthol
Naphtholis Salicylas
Cresol (official)
Thymosalol
} These are preparations which act like salol.

Antipyrine salicylate, Phenocoll salicylate, Saliphen, Malakine, are all used mostly to reduce fever, though they also act like salicylic acid which they form in the body. (See analgesic antipyretics.)

COLCHICUM (MEADOW SAFFRON)

Colchicum is obtained from the seeds, **Colchici semen** and underground stems, **Colchici cormus,** of the meadow saffron or **Colchicum autumnale,** a small plant growing in Europe and England. The active principle is a substance called **colchicine.**

Appearance of the Patient

An ordinary dose of colchicum causes very little effect, but several hours after a moderate dose is given, the patient complains of some abdominal pain, perhaps of a little nausea, and later he has frequent movements of the bowels and the urine may be somewhat increased. The pulse may be a little slower and occasionally the tears, saliva and sweat are somewhat increased.

If the patient is suffering from an attack of acute gout, the severe pains of this condition are usually relieved.

ACTION

Local action: Applied to the skin or mucous membranes, it acts as an irritant.

When given internally it irritates the mucous membrane of the stomach, causing nausea and vomiting.

It is slowly absorbed from the stomach. After absorption it principally affects acute gout. It also increases the secretion of urine. Large doses make the pulse and breathing somewhat slower.

Action in Gout

Acute gout is a disease characterized by severe pain, redness and swelling of one or more joints of the body. The joints of the toes and hands are particularly affected, and the pains more often occur at night. The disease is said to be due to the deposit in the joints, of crystals of uric acid, which is ordinarily a fluid constituent of the urine.

Colchicum relieves particularly the pains of acute gout, though it is not really a specific for that disease.

Poisonous Effects

Colchicum is a very violent poison, small doses having caused death. An overdose of colchicum usually causes the following symptoms within a few hours:

1. Severe abdominal pain.
2. Nausea, and continual profuse vomiting, which is accompanied by profuse secretion of saliva, tears and mucus from the nose.
3. Profuse diarrhoea, often with bloody stools.
4. Scanty and bloody urine, or there may be no urine secreted at all. Occasionally the urine may be increased.
5. Spasms of the muscles, even convulsions, followed by great muscular weakness, with slow movements and paralysis.
6. Collapse (rapid, thready pulse, slow and shallow breathing, cold moist skin).

Death soon results from respiratory paralysis.

Treatment

1. Give tannic acid preparations, to neutralize the colchicum.
2. Wash out the stomach.

3. Protect the mucous membrane by white of egg, milk, etc. (demulcents).

4. Keep the patient quiet.

5. The collapse is treated with stimulants, such as caffeine, strychnine, etc.

Preparations

Colchicum Stems

Extract of Colchicum Stems (**Extractum Colchici Cormi**)	0.03–0.12 gm.	grs. ½–ii

Colchicum Seeds

The preparations of the seeds are principally used.

Wine of Colchicum Seeds (**Vinum Colchici Seminis**)	0.6–4.0 c.c.	m. x–℥i

This contains 10% of colchicum and is the preparation commonly used.

Fluidextract of Colchicum Seeds (**Fluidextractum Colchici Seminis**)	0.1–0.3 c.c.	m. ii–v
Tincture of Colchicum Seeds (**Tinctura Colchici Seminis**)	0.3–1.0 c.c.	m. v–xv
Colchicine (the active principle)	0.0005 gm.	gr. $\frac{1}{120}$

PIPERAZINE (not official)

Piperazine is a chemical substance which is frequently used to relieve gout, and to dissolve stones in the kidney and bladder. Its use is based upon the fact that it dissolves uric acid crystals, when added to them in a test tube. Practical experience in the use of this drug has not borne out this effect on the patient. It slightly increases the flow of urine, however.

Preparations

Piperazine (**Piperazina**)	0.3–0.6 gm.	grs. v–x
Lycetol **Dimethyl Piperazine Tartarate**	1.0–2.0 gms.	grs. xv–xxx
Sidonal or Piperazine Quinnate (**Piperazinae Quinnas**)	1.0–1.3 gm.	grs. xv–xx

ATOPHAN OR CINCHOPHEN

Atophan, cinchophen, or **phenylcinchoninic acid**, is a white, crystalline substance which is made chemically from various other complex substances.

ACTION

Atophan has a specific action in acute gout. **It relieves the pains around the joints very promptly.** It increases the secretion of urine and the amount of uric acid contained in it. Beneficial effects have also been obtained from its use in other chronic joint affections, such as rheumatism, etc.

It is not a poisonous drug, and is therefore safer than colchicum.

Preparations

Atophan or Cinchophen Phenylcinchoninic Acid	0.3–1.0 gm.	grs. v–xv
Novatophan	0.3–1.0 gm.	grs. v–xv
Paratophan	0.3–1.0 gm.	grs. v–xv

CIMICIFUGA (BLACK SNAKEROOT)

Cimicifuga is obtained from the roots and underground stems of the **Cimicifuga racemosa,** an American plant which grows abundantly in shady woods.

It is used as a bitter, to relieve gout and rheumatism, and occasionally to relieve nervousness.

Preparations

Extract of Cimicifuga (Extractum Cimicifugae)	0.3–1.0 gm.	grs. v–xv
Fluidextract of Cimicifuga (Fluidextractum Cimicifugae)	1.0–4.0 gms.	m. xv–℥i
Tincture of Cimicifuga (Tinctura Cimicifugae)	4.0–8.0 c.c.	℥i–ii

EMETINE

Emetine is a white powder, the active alkaloid of ipecac. It was formerly used only to produce vomiting. Locally it is an antiseptic. It is especially destructive to amoebae, which are unicellular organisms many species of which cause disease particularly in the large intestine. Even a solution of 1 to 1,000,000 destroys amoebae.

Applied to the skin emetine is very irritating and may cause pustules if applied long enough.

When given by mouth or hypodermically in large doses it causes nausea and vomiting. On account of its destructive action on amoebae it is principally used as a specific in amoebic dysentery, a form of dysentery caused by a species of amoebae.

Emetine has also been used extensively in the treatment of pyorrhoea alveolaris, an infected condition of the teeth sockets. Amoebae are found in the pus of this disease, but they are evidently not the cause of it. Emetine is beneficial in this disease but it does not cure it.

Emetine has also been used to check haemorrhage from the lung (haemoptysis).

Poisonous Effects

The poisonous effects that result from emetine are abdominal pain, pain on passing stool and delirium.

Emetine Hydrochloride 0.01–0.02 gm. gr. $\frac{1}{6}$–$\frac{1}{3}$

It is usually given by hypodermic injection. In pyorrhoea alveolaris it is also applied locally to the gums.

RADIUM

Radium is a chemical element obtained from Hungary. The salt commonly used in medicine is **radium bromide.** This usually comes in sealed glass tubes enclosed in gold, silver or platinum. Radium differs from other chemical substances in a very singular way. It is constantly giving off atoms in the form of invisible rays which are capable of producing energy and destroying tissue. Substances which

have this property are said to be radio active. The constant loss of the atoms takes place so slowly that the action of the radium is not materially lessened by constant use. In fact, it is claimed that radium will retain its activity for about 2500 years.

The active rays of radium are able to destroy tissues and are of three kinds: alpha, beta and gamma rays. The gamma rays are the most penetrating and are able to reach deep tissues, while the alpha and beta rays affect only the superficial cells. The alpha rays may be screened off by interposing a piece of paper between the radium and the tissue to be affected, and the beta rays by a thin piece of lead.

ACTION

Radium acts only locally, on direct application to the tissue to be treated. If a tube of radium is applied for some time on the normal skin, it will produce a red and tender area with the formation of a scab. A longer application, or a stronger tube, will form an ulcer which heals readily, however.

When applied for some time to a cancer, radium destroys some of the cancer cells, checks its growth and relieves the pain.

Uses and Administration

Radium is used principally in the treatment of cancer and rodent ulcer (a peculiar progressive form of ulcer which spreads over the face and destroys the various tissues).

It is usually applied by inserting the gold, silver, or platinum covered tube of radium into the cancer tissue or by placing it on the ulcer.

Thorium and **Mesothorium** are two other radio active substances that are used in the treatment of cancer. They are much cheaper than radium but not as active.

RADIUM EMANATION

Radium emanation is a gas which is constantly being given off from radium. It is obtained by placing a radium

containing substance in a bottle of water and allowing it to stand for some time when the water becomes charged with the emanation. This is used as a drink in chronic rheumatism and gout with beneficial results.

The gas may also be collected from the surface of the water and used as an inhalation in the treatment of diseases of the lungs.

CHAPTER XXIX

SERUMS AND VACCINES

SERUMS

When a patient suffers from an infectious disease, and then recovers, the disease has been overcome by the formation in the blood of antibodies (antidotes) against the causative agent of that particular infection. The patient is then said to have developed an **active immunity** against the disease, because he himself has formed the antibodies (antidote).

Similarly, when an animal is injected with bacteria or their poisonous excretions (toxins) in gradually increasing doses, the animal develops an active immunity against the injected bacteria or their toxins. The **serum** of such an animal can then be injected into patients to overcome a similar infection. As a result of the injection the patient becomes immunized against the disease. Immunity produced in this way is called **passive immunity** because it was the result of antibodies (antidotes) formed in the blood of another animal.

A serum is the serum of an animal that has been immunized against a particular bacterium or its toxins. Serums are of two kinds: **bacteriolytic**, and **antitoxic**.

BACTERIOLYTIC SERUMS

A bacteriolytic serum is the serum of an animal that has been immunized against particular bacteria. The horse is the animal commonly used for the manufacture of serums since the largest quantity of serum can be obtained from this animal.

Method of Manufacture

A horse is injected with a small dose of a solution of the

particular bacteria against which the serum is desired. The horse then becomes ill and has a rise of temperature, which disappears in a few days. When the animal is well again, the injection is repeated, but with a larger dose; which now does not produce such severe symptoms.

The injections are repeated until the animal can stand injections of large doses of the bacteria without any symptoms being produced. The horse is then immune against these particular bacteria, and his serum contains antibodies (antidotes) against the bacteria with which he was injected. The animal is then bled from the Jugular vein, the blood is allowed to clot, and the serum is removed under strictly aseptic precautions. This serum, when injected into patients suffering from an infection produced by the same bacteria, neutralizes their poisonous effects; the antibodies of the serum combining with the bacteria.

Preparations

Antistreptococcus Serum

This serum is used in the treatment of septicaemia, erysipelas, scarlet fever. It is made by immunizing horses against Streptococci.

Polyvalent Antistreptococcus Serum

This is made by immunizing horses against several different strains of Streptococci.

Antistaphylococcus Serum

This is made by immunizing horses against dead Staphylococci. It is used in the treatment of sepsis caused by Staphylococci.

Antipneumococcus Serum

This is the serum obtained by immunizing horses against dead and living Pneumococci. It is used in the treatment of pneumonia.

Antigonococcus Serum

This is the serum of rams immunized against dead and

living Gonococci. It is especially valuable in the treatment of gonorrhoeal joints.

Antidysenteric Serum

This is the serum of horses immunized against the dysentery bacillus (Shiga bacillus).

Antimeningococcus Serum

This is the serum of horses immunized against dead and living Meningococci. It is injected in 15–30 c.c. doses into the spinal canal, after the same amount of fluid has been withdrawn from the canal.

Antityphoid Serum

This is the serum of horses injected with dead cultures of typhoid bacilli.

ANTITOXIC SERUMS

An antitoxic serum is the serum of an animal that has been immunized against the poisonous excretions (toxins) of bacteria, but not against the bodies of the bacteria themselves.

Antitoxic serums are prepared in the same way as antibacterial serums but the animal is repeatedly injected with a filtrate of a bouillon culture of the bacteria obtained through a Berkefeld filter. This filtrate contains only the toxins of the bacteria, but not their bodies.

Preparations

Diphtheria Antitoxin Serum

This is the serum of a horse that has been immunized against the toxin of the diphtheria bacilli. It contains antibodies against the diphtheria toxin. When the serum is injected into a patient suffering from diphtheria, the antibodies combine with the diphtheria toxin, thereby neutralizing the symptoms of the disease.

Diphtheria antitoxin is the most efficient serum which is used at the present time. The disappearance of the membrane in the throat, and the clearing up of all the toxic symptoms result in one to two days after the injection.

It is usually given in doses of 5000 to 10000 units intramuscularly, and in severe cases intravenously (an antitoxic unit is the amount of antitoxin that will immunize a guinea pig weighing 250 gms. against 100 times the fatal dose of diphtheria toxin). It should be repeated every 12 hours until all the symptoms disappear. It should always be given early in the disease. In the later stages the diphtheria toxin may have already combined with the nerve cells and complications may then result, but no case is hopeless.

Diphtheria antitoxin is also given in doses of 500 to 1000 units to those who are exposed to diphtheria cases, to prevent them from contracting the disease (thus immunizing them).

Diphtheria Antitoxin (Concentrated)
Refined Diphtheria Antitoxin
(Antidiphtheritic Globulins)

These are all specially prepared antitoxins from which some of the inactive serum albumins have been removed, so that smaller quantities of serum may be used to produce the same effects.

Tetanus Antitoxin

This is the serum of a horse that has been immunized against the toxins of the Tetanus bacilli.

It is given in doses of 3000 to 20000 units every 4 to 8 hours. As an immunizing dose about 1500 units are given.

BACTERIAL VACCINES

Bacterial vaccines are solutions of dead bacteria in normal salt solution. A $\frac{1}{2}\%$ carbolic acid solution is usually added as a preservative.

They are used to immunize patients against infections caused by the same kind of organisms as those that are injected. There are two kinds of vaccines: Autogenous vaccines and stock vaccines.

Autogenous vaccines are solutions of bacteria, obtained from the patient who is being treated.

Stock vaccines are solutions of bacteria obtained from other sources.

The principle upon which the action of vaccines is based, is the following: The injection of the dead bacteria into the patient, causes the formation, in the serum of the blood, of a substance which excites the phagocytic action (destructive action) of the white blood corpuscles, so that they take up and destroy the bacteria of the blood more readily.

The substances formed in the serum by the dead bacteria, which increase the phagocytic action of the white blood corpuscles, are called opsonins.

Preparations

Staphylococcus Vaccine

This is a solution of dead Staphylococci and is used in the treatment of acne, furuncles and other Staphylococcus infections.

Streptococcus Vaccine

This is a solution of dead Streptococci in salt solution. It is used in treating Streptococcus infections.

Typhoid Vaccine

This is a solution of dead typhoid bacilli in salt solution. It is injected into patients to prevent them from contracting typhoid fever when they are exposed to that disease (immunizing them against typhoid).

Gonococcus Vaccine

This is a solution of dead Gonococci in normal salt solution and is used principally in the treatment of gonorrhoeal joints.

Bacillus Coli Vaccine

This is a solution of dead colon bacilli in normal salt solution.

Pneumococcus Vaccine

This is a solution of dead Pneumococci in normal salt solution.

Coley's Serum

This is a mixture of Bacillus prodigiosus and Streptococci, which is used in the treatment of sarcoma.

Lactic Acid Bacilli

A number of bacilli which sour milk by the formation of lactic acid, have recently been used very extensively in medicine. The most important organism of the group is the **Bacillus bulgaricus.** The presence of these harmless bacilli in the intestines, and their formation of lactic acid, prevent the growth of other harmful bacteria which cause intestinal fermentation and putrefaction. Cultures of these bacilli, in solid or liquid form are therefore given to lessen intestinal fermentation and to relieve various symptoms resulting from this condition.

They are frequently given in the form of milk fermented with cultures of these organisms. Kumyss, Matzoon, Zoolak, Fermilac, etc., are similar preparations of fermented milk.

Solid Preparations

Bulgara Tablets 2 tablets

A pure culture of Bacillus bulgaricus.

Lactic Bacillary Tablets 1–2 tablets

Fluid Preparations

Massolin

This is a pure culture of Bacillus bulgaricus of Massol, grown in broth to which calcium salts have been added. It is often applied to the throat after an attack of diphtheria when the bacilli are still present

Lactampoule and a number of other preparations.

There are a number of preparations of milk on the market containing bulgaric bacilli, such as **Fermillac, bacillac, zoolak, etc.**

OTHER SERUMS

Old Tuberculin

This is a solution obtained by filtering a bouillon culture of living tubercle bacilli through a Berkefeld filter and adding a little glycerine to it as a preservative. It contains the toxins of the tubercle bacilli. It is now only used to diagnose tuberculosis, either by injection, which causes a rise in temperature, or by the application to the skin.

New Tuberculin

This is made by grinding up tubercle bacilli and mixing them with equal parts of water and glycerine.

Vaccine Virus

This is the pus obtained from the pustules of calves suffering with cow pox. The pus is obtained under sterile precautions and a little glycerine is added as a preservative. It is used for vaccination against small pox.

The principle of vaccination depends on the fact that an individual who has had an attack of cow pox, becomes immune against small pox. Vaccination produces a mild attack of cow pox at the site of the application of the virus. This makes the patient immune against small pox.

Antirabic Vaccine

This is an emulsion of the spinal cords of rabbits who have been inoculated with rabies (hydrophobia) poison. After the animals have been inoculated, they are killed and their spinal cords removed. The cords are dried, ground and made into an emulsion in normal salt solution. This emulsion is used in the treatment and prevention of hydrophobia. The treatment is begun with the injection of a weak emulsion of a cord which has been dried for a long time, and is followed by the injection of stronger emulsions (containing cords which have been dried for a shorter time.)

Normal Horse Serum

This is ordinary serum obtained by coagulating horses' blood, and removing the serum. It is injected into patients to increase the clotting of the blood.

Leucocyte Extract

This is a fluid made by injecting **aleuronat** (diabetic flour) into the chests of rabbits. This forms a thick fluid (exudate) which contains a large number of white blood corpuscles. It is used in 10.0 c.c. doses in the treatment of pneumonia.

Nuclein 0.3–0.6 gm. grs. v–x

This is a compound of phosphorus and proteins which is said to increase the number of white blood corpuscles and thereby to destroy bacteria.

Dunbar's Serum (Pollantin): This is the serum of horses that have been immunized against the pollen of common weeds or grasses which are believed to be the cause of hay

fever. It is used in the treatment of hay fever and is given hypodermically or applied locally.

Pollen Extract or Pollen Vaccine: Pollen extracts are watery extracts of the pollens of various plants such as ragweed, timothy, maize, goldenrod, etc. These pollens are believed to be the cause of hay fever. Pollen extracts are injected into patients who are susceptible to them to produce immunity against Fall Hay Fever.

The patient is first tested with an extract of each kind of pollen to determine which one he is susceptible to. This is done by scraping several very small spots on the skin of the arm and applying a different pollen extract on each spot. An area of redness and swelling (wheal) forms at the spot where the pollen to which the patient is susceptible has been applied. In this way we can determine the various pollens to which the patient is susceptible. The degree of susceptibility to the specific pollen is then tested by applying 25%, 10%, 1% respectively, or even weaker solutions. About 0.3 0.6 c.c. (m. v–x) of the weakest solution which gives a reaction is then injected hypodermically. This solution is gradually increased in strength with each injection until the patient is immunized. The effect lasts only for one year.

An overdose may cause a severe attack of asthma.

Food Proteins: A number of diseases, asthma for example, are believed to be due to an unusual susceptibility to various protein constituents of certain foods such as eggs, fish, etc. The susceptibility of the patient to the proteins is usually determined by scarifying a small spot on the arm in the same way as is done for vaccination, and applying a few minims of a solution of different proteins on these spots. If an elevated area of redness (wheal) occurs at the site of application, the patient is said to be sensitive to the protein which caused it.

The treatment with the proteins consists of injecting a few minims of the weakest solution that produces a reaction and gradually increasing the dosage until the patient is immunized.

Administration of Serums and Vaccines

The serums and vaccines are usually given hypodermically or intramuscularly. For immediate effect many serums are injected intravenously.

Anaphalaxis (Serum Sickness)

In some individuals the injection of a serum causes some or all of the following symptoms:

1. Fever.
2. Headache.
3. Urticaria (hives).
4. Oedema of various parts of the body.
5. Attacks of asthma.
6. Collapse.

These symptoms are due to the injection into the tissues of a fluid that contains proteins of bacteria, animals or plants. When such proteins are taken as food anaphalaxis may not occur.

The symptoms may be avoided by finding whether the patient has been subject to attacks of asthma or hives, or whether previous injections of a serum have caused these symptoms.

The susceptibility of a patient to a serum may also be tested by injecting a few drops of the serum hypodermically and noting whether a small oedematous red spot occurs at the site of injection. It takes a few days, however, to determine this. The Schick test is a similar method which has been recently used quite extensively to determine the susceptibility of individuals to diphtheria toxin, thus testing their susceptibility to diphtheria. Individuals showing a negative test are naturally immune to the disease and need not receive an immunizing dose of diphtheria antitoxin when exposed to diphtheria patients.

CHAPTER XXX

ORGANIC REMEDIES

There are a number of substances used in medicine that are obtained from various glands of animals. The various digestive ferments have long been used as substitutes for the absence of similar ferments in various diseases of the digestive tract. Besides these, however, substances have been obtained from the so-called glands of internal secretion or the endocrine glands. These glands secrete substances into the blood stream which influence in a very profound way the growth, development and activities of the body and probably also its resistance to disease.

A number of substances have been obtained from these glands which have distinct curative value. Indeed, in certain diseases they are even specifics. For example, in Myxoedema or Cretinism, two diseases that result from deficient secretion of the thyroid gland, thyroid extract, an extract made from thyroid glands, is a real specific.

On the other hand, definite substances may be obtained from some of the glands which have distinct pharmacologic effects so that these substances may be used in any disease where such effects are desired. For example, epinephrin or adrenalin is a substance obtained from the adrenal glands of sheep. It contracts the blood vessels and acts as a heart stimulant producing effects quite similar to those of digitalis. Pituitrin is another substance which is obtained from the pituitary gland, a small gland situated at the base of the brain, which causes definite contractions of the involuntary muscles of the intestines and the uterus. It is therefore used with brilliant effects to produce uterine contractions and to expel the contents from the intestines. The number of substances that are being obtained from the glands of internal secretion that are of distinct value are increasing from day to day.

Furthermore, since the glands for internal secretion play such an important rôle in the development, the activities and the immunity of the body, it is becoming more and more evident that in many diseases the disturbance in the function of one or several of the glands of internal secretion may be an important direct or associated causative factor in these diseases.

The administration of gland extracts gives such brilliant specific curative effects in those cases where the disturbance of the gland is recognized as in the treatment of Myxoedema with thyroid extract for instance. Consequently the administration of glandular extracts is often equally beneficial in other diseases where signs of an associated deficiency of the glands for internal secretion are present besides the usual symptoms of the disease. For example, overactivity of the thyroid gland is characterized by a rapid pulse, twitchings of the fingers, bulging of the eyeballs, sweating and nervousness. Consequently the occurrence of some of these symptoms in any disease such as stomach disease for instance, indicates that the over-acting thyroid gland is either a direct or an associated cause of this disease. Or, since Myxoedema or hypothyroidism is characterized by mental sluggishness, drowsiness and the formation of fat pads and dryness of the skin, the presence of these symptoms in any other disease indicates that the deficient thyroid secretion plays an important rôle in the cause of this other disease. And so, in many diseases we may frequently find, sometimes slight, at other times marked evidence of deficient function of some of the glands of internal secretion.

There is therefore an increasing tendency on the part of many physicians to prescribe glandular substances in many diseases other than those due to disease of the glands for internal secretion. The gland that is prescribed in any disease is the one whose secretion is apparently deficient. This is determined by the presence of a number of symptoms that indicate its deficiency, such as the mental sluggishness, fat pads, dryness of the skin, etc., for example, which indicate thyroid deficiency.

THYROID EXTRACT

Thyroid extract is a powder made by grinding up the thyroid glands of sheep. The active principle is a substance called **thyroxin** which has recently been isolated.

ACTION

The thyroid gland is a ductless gland which secretes a substance into the blood. This substance regulates the growth and development of the body and it probably also influences the function of many other organs of the body. It increases the metabolism of proteins and fats, thereby causing a loss in weight. It also aids in the growth of bone. The effect of the thyroid gland on the body can best be understood by a study of the symptoms which result when the thyroid is absent, when it is atrophied, or when it is acting excessively.

When the thyroid gland is absent or very poorly developed which is not infrequently the case in children, a condition known as **cretinism** develops due to the fact that the thyroid gland is not functionating. These children are stunted in their growth, they develop pads of fat in the neck and other parts of the body, they have a slow pulse, they are dull and stupid, their intelligence is very poor and they make no progress in school.

The continued administration of thyroid extract to such children is followed by startling improvement in their growth and development; indeed all the symptoms of the condition gradually disappear.

In old people the thyroid gland frequently becomes atrophied; thus diminishing its secretion. These individuals suffer from symptoms similar to those that occur in Cretinism. They become drowsy, they are dull mentally, they become stout and pads of fat develop in the neck and other parts of the body. This condition is called **Myxoedema** and is promptly relieved by continued administration of thyroid extract.

When the thyroid gland secretes excessively a condition known as Hyperthyroidism occurs. In severe cases the

thyroid gland is very much enlarged and the eyeballs bulge out (exopthalmos). Consequently the disease is frequently called **Exopthalmic Goitre**; also Grave's or Basedow's disease after the men who first described the condition. The principal symptoms of this disease are a rapid pulse, nervousness, very fine twitchings of the fingers, bulging of the eyeballs, diarrhoea, profuse sweating and in severe cases enlargement of the thyroid gland.

Effects

When thyroid gland is given to patients who have an apparently normal thyroid secretion it may cause a slight loss in weight and it slightly increases the rapidity of the pulse.

Uses

Thyroid extract is used in a great many conditions but the diseases in which it is distinctly indicated are those in which there is a deficient secretion of the thyroid gland. These conditions are Myxoedema and Cretinism and thyroid is a specific for them. If the treatment is begun early enough the symptoms all disappear but it must be kept up for the rest of the patient's life since the thyroid extract merely substitutes the deficient secretion.

Since the feeding of thyroid extract to patients with Myxoedema causes the disappearance of the deposits of fat, thyroid extract is frequently used to reduce weight in obesity. It must be used with great care in this condition since poisonous symptoms may occur before the weight has been appreciably reduced.

Many patients suffering from other diseases such as various forms of stomach disease may show some of the symptoms characteristic of deficient thyroid secretion such as abnormal drowsiness, mental dullness, dryness of the skin, etc. These symptoms are believed to indicate that the deficient thyroid secretion is an important causative factor in these diseases. Consequently they are treated with thyroid extract and very often with beneficial results.

Thyroid extract is also used in various other diseases such as chronic arthritis (chronic inflammation of the joints) be-

cause these diseases are supposed to be due to a disturbance in the thyroid secretion. It is also given to stimulate the healing of ununited fractures and in osteomalacia and rickets, two conditions of undue softening of the bones.

Thyroid extract is also used in disturbances of various other glands of internal secretion on the theory that excessive action of these glands results from an effort to compensate for a deficient thyroid secretion, or that thyroid extract helps their function.

Poisonous Effects

When excessive doses of thyroid extract are taken symptoms of excessive thyroid secretion result. The symptoms are the same as those which occur in Hyperthyroidism or Exopthalmic Goitre. When these symptoms occur the administration of thyroid extract should be stopped.

Symptoms

1. Rapid loss in weight.
2. Rapid pulse.
3. Nervousness.
4. Twitching of the fingers.
5. Bulging of the eyeballs.
6. Diarrhoea.
7. Enlargement of the thyroid gland.

Preparations

Thyroid Extract (Glandulae Thyroidae Siccae)	0.006–0.3 gm.	grs. $\frac{1}{10}$–v
Antithyroidin Moebius	0.5–1.0 c.c.	m. viii–xv

This is the serum of goats in whom the thyroid glands have been removed about six weeks before the serum is removed. It is used in the treatment of exophthalmic goitre (excessive thyroid secretion).

Thyroidectin	0.3 gm.	grs. v

This comes in gelatin capsules which contain a powder made from the dried blood of animals whose thyroid glands

have been removed. It is used in cases of excessive thyroid secretion (Hyperthyroidism or Exopthalmic Goitre).

PARATHYROID EXTRACT

Parathyroid extract is a powder made from an extract of the parathyroid glands. These are very small glands situated in the region of the thyroid gland.

ACTION

The action of the parathyroid glands can best be understood by a study of the symptoms that result from their removal. This often happens in the removal of the thyroid gland, in which the parathyroids are imbedded. The removal of the parathyroids is followed by a condition known as tetany. This condition also occurs spontaneously in children. It is characterized by the occurrence of intermittent or spasmodic or tetanic contractions of the muscles of the arms and hands, sometimes also of the lower extremities.

These symptoms are due to the deficient secretion of the parathyroid glands which regulate the metabolism of calcium salts. As a result of the consequent deficient calcium in the body the nerves become more irritable; since calcium is a necessary substance for proper action of nerve tissues.

Parathyroid extract is also given to lessen the twitchings of the hands in paralysis agitans, a disease characterized by continual twitchings of the hands and a shuffling gait. It is also used to lessen the convulsions of eclampsia, a condition occurring in pregnancy.

Preparations

Parathyroid Extract	0.003–0.006 gm.	gr. $\frac{1}{20}$–$\frac{1}{10}$
Dessicated Parathyroid Gland		

PITUITARY EXTRACT

Pituitary extract is a powder made from the pituitary gland of the ox. The pituitary gland is a small gland sit-

uated at the base of the brain. It is a ductless gland which secretes a substance which enters the blood stream. The gland consists of two parts: an anterior lobe and a posterior lobe. Each lobe has a different function. The active principle of the anterior lobe is a substance called **tethelin.** The posterior lobe contains a substance known as **pituitrin** which produces definite effects.

The effect of the pituitary gland on the body can best be understood by a study of the symptoms which result when the pituitary gland is secreting excessively or when its secretion is deficient. Since each lobe of the gland has a different function, the effects differ according to whether the anterior or posterior lobe of the gland is involved.

The **anterior lobe** of the gland regulates growth and development particularly of the bones; for when the secretion of this lobe is excessive, the growth of the bones is increased. As a result the individual is of large stature with large extremities out of proportion to the rest of the body.

The **posterior lobe** of the gland secretes a substance into the blood which causes contraction of all the involuntary muscles. It therefore causes contractions, it raises the blood pressure, it contracts the bladder and it increases the metabolism and indirectly stimulates the action of the genital glands. It also increases the flow of urine and the secretion of milk.

When the anterior lobe of the pituitary gland secretes excessively a condition known as **acromegaly** or **gigantism** develops. This is characterized by excessive growth of the skeleton. The individual is of large stature, he has abnormally long extremities so that the individuals are the so-called giants, if the disturbance in the gland occurs in childhood before the bones have completely ossified. If the disturbance in the gland occurs later in life, about the period of adolescence, a condition known as acromegaly develops. The patient is not usually of large stature but the bones of the face are enlarged and thickened so that the features become coarse, large and prominent (the so-called lion-like face). The fingers and the toes become thick, broad and square and the hair over the body is profuse and bushy.

When the secretion of the anterior lobe of the pituitary gland is diminished, usually as a result of a very small-sized or atrophic gland, if this disturbance occurs in infancy the individuals remain dwarfs. If it occurs later in life the individuals have small, thin hands, small teeth packed close together, highly arched palate and have a subnormal mentality and show defective bone development generally, with scanty growth of hair and a tendency to obesity.

When there is a disturbance of both lobes of the pituitary gland usually as a result of disease, the secretion is markedly diminished and the condition known as **Hypopituitarism** or **dystrophia adiposogenitalis** or Froehlich's disease results. This is characterized by localized deposits of fat usually about the breasts and buttocks with a change in the physical characteristics of the individual that determine the sex. The skin is dry scaly alabaster like. There also develops a peculiar blindness in which patients do not see objects on either side of them, due to pressure on the optic nerve. If the patient is a woman the breasts become smaller, she stops menstruating and develops a growth of hair on the face. In male patients the growth of hair on the face diminishes the breasts become larger and the sexual glands become atrophied.

These symptoms gradually improve with the administration of the pituitary gland extracts especially of the anterior lobe since most of the symptoms are due to deficient secretion of the anterior lobe.

Uses

Anterior lobe extract is used as a specific to supply deficient secretion of the anterior lobe in Hypopituitarism, infantilism, dwarfism and in the late stages of acromegaly.

Posterior pituitary lobe extract is used as a heart stimulant in shock or collapse and to raise the blood pressure. It is also used to increase peristalsis in abdominal distention (tympanites) following operations and in the course of various infections, and to increase uterine contractions in labor. It is used to check the excessive secretion of urine in diabetes insipidus which is believed to be due to deficient action of

the posterior lobe of the pituitary gland. It is also given in epilepsy.

Since deficient action of the pituitary gland is characterized by characteristic symptoms, the presence of these symptoms in any disease is considered by some physicians to play a causative rôle in the disease and consequently pituitary extracts are used in the treatment of many other diseases.

Poisonous Effects

When excessive doses of pituitary extract is given there usually occurs a characteristic headache in both temples which indicates that the drug should be stopped.

Preparations

Pituitary Body Dessicated 0.06–0.2 gm. grs. i–iii

This is the dried substance of the entire pituitary gland of the ox. It comes in tablets.

Dessicated Pituitary Substance (Anterior Lobe) 0.06–0.25 gm. grs. i–iv

This is the powdered dried substance of the anterior lobe of the pituitary gland of the ox. It also comes in tablets.

Dessicated Pituitary Substance (Posterior Lobe) 0.06–0.25 gm. gr. i–iv

This is the dried powdered posterior lobe of the pituitary gland of the ox.

Dessicated Hypophysis 0.03 gm. gr. $\frac{1}{2}$
Hypophysis Sicca

This is a yellowish powder made from the posterior lobe of the pituitary gland.

Solution of Hypophysis 1.0 c.c. m. xv
Liquor Hypophysis

This is a sterile solution of the extract of the posterior lobe of the pituitary gland. It comes in ampoules each containing 1.0 c.c. (m. xv).

The following are preparations of solution of hypophysis:

Pituitary Liquid
Solution Pituitary Extract
Pituitrin

ADRENAL EXTRACT

Adrenal extract is made from the dried suprarenal or adrenal glands of the sheep and ox. These glands are situated immediately above the kidneys and they consist of two portions: an outer part or cortex, and an inner portion or medulla. The cortex and medulla each secrete a substance into the blood which has a profound effect upon the function of the body.

The function of the cortex is not definitely known but it is believed to play a part in the development and growth of the sexual organs. The medulla of the gland secretes a substance into the blood which acts on all the involuntary muscles by stimulating their nerve terminals of the sympathetic system. Epinephrine or adrenalin is a substance obtained from the medulla of the gland which produces the same effect. It contracts the involuntary muscles in the small blood vessels, raising blood pressure for a short time, slowing the pulse, dilating the pupil, increasing the secretions such as the saliva, the tears and contracting the involuntary muscles of the intestines.

When the secretion of the adrenal glands is deficient which not infrequently is the result of disease, a condition known as Addison's disease results. This is characterized by extreme weakness and particularly by weakness in the muscles, by low blood pressure, by bronze coloring of the skin, and finally death.

Lesser degrees of insufficient adrenal secretion occur, characterized by extreme weakness, low blood pressure, sensitiveness to heat and cold, anaemia and constipation, which are more amenable to treatment.

Adrenal extract is used in the treatment of these conditions, but in Addison's Disease the condition is so progressive that it is not of much value.

Epinephrine or Adrenalin is used as a heart stimulant, as a local application on mucous membranes in the nose and throat and in asthma and urticaria (see page 240).

Excessive secretion of the adrenal glands occurs but very little is definitely known about it.

Preparations

Dried Suprarenal Gland **Suprarenalum Siccum**	0.015–0.25 gm.	gr. $\frac{1}{4}$–iv
Solution of Epinephrine hydrochloride	0.12–1.0 c.c.	m. ii–xxx
Solution of Adrenalin chloride		

These are 1–1000 solutions of epinephrine or adrenalin.

OVARIAN EXTRACTS

Ovarian extract is a powder obtained as an extract from the ovary.

The ovaries are two glands situated at the side of the uterus. They secrete the ova into the uterus. Besides the secretion of the ova the ovaries secrete a substance into the blood which has a profound effect on the function of all the other genital glands. This internal secretion also influences many of the other functions of the body; particularly the nervous system and metabolism. It is believed that the internal secretion of the ovaries originates in the corpus luteum, which is a small body formed in the ovary at the site of the discharged ovum. During pregnancy this body undergoes rather characteristic changes.

ACTION

The action of the internal secretion of the ovary can be understood by a study of the symptoms that result when this secretion is diminished. This occurs at the time of the menopause which is the period when a woman ceases to menstruate and after both ovaries have been removed during an operation. At this time as a result of the deficient internal secretion of the ovary, the patient ceases to men-

struate, she becomes very nervous and irritable, she gets flushing of the face and becomes unusually stout.

It is also believed that amenorrhoea (cessation of menstruation) scanty, irregular and painful menstruation (dysmenorrhoea) and the vomiting of pregnancy are due to a disturbance of internal secretion of the ovaries.

Ovarian extract is used to relieve the nervous symptoms, the flushes and the obesity which occur at the menopause whether natural or following the removal of the ovaries.

It is also used to relieve scanty, painful and irregular menstruation as well as various skin diseases which occur at the time of the menopause.

Preparations

Ovarian Substance	0.06–0.2 gm.	grs. i–iii
Ovarian Extract		

Corpus Luteum

Corpus luteum is an extract made from the corpus luteum of the cow. These are small yellow bodies which are formed in the ovary at the site of the discharged ovum. It is believed that the internal secretion of the ovary is formed in the corpus luteum. Consequently it is used in the same conditions as ovarian extract but it is believed to be better.

Preparations

Corpus luteum dessicated	0.12–0.3 gm.	gr. ii–v

This comes in capsules or tablets made from the fresh corpulutea of cow's ovaries.

Lutein	0.12–0.3 gm.	gr. i–v

This is made from the corpus luteum of the hog but it is 4 times as strong as the fresh substance.

THYMUS EXTRACT

Thymus extract is a powder made from the fresh thymus gland of the calf. The gland is situated in the chest, behind the sternum. It regulates the growth and development of

the child. Since it regulates growth and development of bone it is used in the treatment of chronic rheumatism with bony changes and in rickets.

MAMMARY EXTRACT

Mammary extract is a yellowish powder made from the mammary glands (breasts) of sheep.

The nursing of the child and the flow of milk from the breast causes contraction of the uterus; an effect which is believed to be due to an internal secretion of the breast. Consequently mammary gland extract is given to contract the uterus and therefore to check profuse menstruation (menorrhagia) and the excessive bleeding occurring at the time of the menopause.

Mammary substance	0.12–0.3 gm.	grs. ii–v

PART X—DRUGS ACTING PRINCIPALLY ON THE SKIN AND MUCOUS MEMBRANES

LOCAL REMEDIES

CHAPTER XXXI

ASTRINGENTS

Astringents are drugs which are used to contract the tissues with which they come in contact. If they are applied to mucous membranes, by contraction of the cells, they lessen the secretions.

Astringents affect the tissues only locally, by combining with the proteins or albumins of the cells and thereby coagulating and hardening them. Such an effect can only be produced when the substance comes in direct contact with the tissues upon which it acts.

In large doses, the excessive coagulation of the proteins of the cells destroys the tissues; this effect is called caustic action.

Astringents may be divided into two groups, depending upon the nature of the substance used for this purpose:

Inorganic or Mineral Astringents
Organic or Vegetable Astringents

INORGANIC OR MINERAL ASTRINGENTS

Mineral astringents are mineral substances which are used to contract tissues and to check the secretions of mucous membranes. Most of these substances are metals and their salts. The principal salts used for this purpose are the salts of **lead, silver, aluminum, zinc, copper and bismuth. Mercury, iron and arsenic** are also astringents, but these are used principally for their effects after absorption. The metals usually act by coagulating the albumins of the cells, forming an albuminate of the metal. Many of their

preparations are already combined with albumins. These are not as injurious to the tissues and are milder in action.

The best astringents are those that are not readily absorbed, such as **silver, bismuth**, copper and zinc. The two latter substances are the most active astringents. In strong solutions they destroy the tissues.

The metals that are readily absorbed are **mercury, iron, arsenic and lead.** Lead is the only one that is used as an astringent, the others are used principally for their effects after absorption.

Of the various salts of the metals, the chlorides and the nitrates have the most astringent action, while the effect of the sulphates and other salts are not as marked.

ACTION

Local action: Applied to the skin, solutions of the metallic astringents produce no effect, but on ulcers or wounded surfaces they coagulate the albumins of the superficial layer of cells, thus contracting them. In this way, they form a thin covering of coagulated albumin, which protects the cells from injury and promotes their healing. If applied to a bleeding spot, they stop bleeding by coagulating the albumins of the blood. **Mucous membranes** are contracted, and their secretions checked, by coagulation of the albumins of their cells.

Internal Action

In the mouth: They have a sweet metallic taste, and make the mouth feel dry by contracting the mucous membrane.

In the stomach and intestines: They check the secretions and lessen peristalsis, thereby causing constipation. They combine with the protein of the food which is then not as readily digested.

Absorption

The mineral astringents combine with the albumins in the stomach and intestines forming albuminates.

If the resulting compounds are readily dissolved in the albuminous fluids which surround them, the metals will be readily absorbed, otherwise they merely act locally. They do not produce any effects, however, unless given for a long time, when they may be deposited in the various tissues of the body and serious poisonous symptoms may develop from some of them. These symptoms will be considered under the various substances from which they occur.

Excretion

The metallic astringents that are absorbed are very slowly eliminated from the body; in the urine, the bile, the intestinal secretions, the saliva and the milk.

Poisonous Effects of Metallic Salts

When large doses of the salts of any of the metals are taken, the following symptoms occur:

1. Burning pain in the mouth. The mouth may be covered with a grayish white membrane, especially after taking silver preparations.
2. Severe abdominal pain.
3. Nausea and vomiting. Often the vomited matter contains blood.
4. Diarrhoea with bloody stools.
5. Collapse.
6. Coma and death.

Treatment

1. Wash out the stomach.
2. Give milk, egg white or old tea to combine with the metal and neutralize it. These substances protect the mucous membrane of the oesophagus and stomach at the same time.
3. The collapse is usually treated with stimulants.
4. Give the chemical antidote.

The following is a list of the chemical antidotes for some of the metals. For the others there is no chemical antidote.

Metal	Antidote
Lead	Dilute sulphuric acid
Silver Nitrate	Sodium chloride (salt)
Alum	Magnesium Hydrate or Ammonium carbonate

METALS

SILVER (ARGENTUM)

Silver is a white, hard, glistening metal. The only salt of silver which is used to any extent in medicine is the silver nitrate.

Silver has been used in medicine for centuries, particularly by the Arabians, who used it extensively in the treatment of nervous diseases. In their system of medicine, which was based upon astrology, silver and nervous diseases were associated with the phases of the same planet, the moon; hence the name lunar caustic for silver nitrate.

Chronic Silver Poisoning ("Argyria")

Argyria is a condition which results from prolonged use of silver salts, but the condition is not very common at the present time.

The silver salts are absorbed into the blood, and deposited in the various tissues of the body. Since silver salts turn a dark color on exposure to light, the skin turns a dark gray or slate color. The skin of the entire body or only various regions of it, such as the face or the gums, may be thus affected.

To relieve the condition potassium iodide is usually given, but it does not usually respond to treatment, however.

Uses

Silver salts are used to check the growth of granulation tissue (newly formed connective tissue) and to contract the mucous membranes of the eye, the nose, or the mouth when these are inflamed.

The salts of silver are particularly valuable in the treatment of gonorrhoeal infections. They destroy the gonococci, the bacteria which cause the disease.

Preparations

The preparations of silver are divided into inorganic and organic preparations. The inorganic preparations are the ordinary salts formed by the combination of silver with a mineral acid. The organic preparations are formed by the combination of silver with albumin.

Inorganic Preparations

Silver Nitrate 0.01–0.03 gm. grs. $\frac{1}{6}$–$\frac{1}{2}$
(Argenti Nitras)

This is used in 1 to 2% solutions dropped in the conjunctiva of the eye, in newly born infants, to prevent gonorrhoeal opthalmia. In other gonorrhoeal infections and for other conditions, it is used in much weaker solutions such as 1–10000 to 1–1000.

Silver nitrate forms an explosive compound with tannic acid.

Moulded Silver Nitrate
(Argenti Nitras Fusus)
(Lunar Caustic)

This comes in hard white sticks in the form of pencils. It is used to destroy excessive granulation tissue and other tissues.

Mitigated Silver Nitrate
(Argenti Nitras Mitigatus)
(Mitigated Caustic)

This consists of one part of silver nitrate and two parts of potassium nitrate, fused into pencils like lunar caustic.

Silver Oxide 0.03–0.12 gm. grs. $\frac{1}{2}$–ii
(Argenti Oxidum)

Organic Preparations

New and Non-official Preparations

These preparations are combinations of silver with albuminous substances. They are therefore not as injurious (irritating) to the tissues, and can be used in stronger solutions as antiseptics.

Argyrol
Silver Vitellin

This is a compound of silver oxide and proteins, containing 20–25% of silver.

It is used locally as an antiseptic and astringent to mucous membranes, in 10–25% solutions; which are not injurious to the tissues. Argyrol should be very carefully used, as it stains linen a dark brown color.

Protargol
Protein Silver Salt

This is a compound of albumin and silver containing 8.3% of silver. It is used as an antiseptic, and as an astringent on mucous membranes in 1 to 10% solutions; as irrigations in 1–1000 to 1–2000 and in the form of bougies and tampons in 5–10% solutions.

Collargol (colloidal silver Credé) 0.06 gm. gr. i
(Collargolum)

This is a solution of very finely divided silver, in albumin, containing about 85% of silver. It is used as an antiseptic both locally, and injected into the blood.

It is often given by direct injection into the veins, in cases of sepsis, in $\frac{1}{2}$% solutions. It is also used in the form of bougies, vaginal suppositories and dusting powders.

Collargol Ointment
(Unguentum Credé)

This contains 15% of collargol. It is used principally in acute mastitis, or inflammation of the breast.

About 2.0–4.0 gms. (grs. xxx–3i) are rubbed thoroughly on the skin.

Albargin
Gelatinose Silver

This is a compound of gelatose with silver, which contains 13–15% of silver.

Argentamin
(Liquor Argentamini)

This is a watery solution of silver nitrate and ethylen diamine containing 10% of silver nitrate. It is used in ¼–4% solutions as an antiseptic in gonorrhoea.

Argonin
Silver Casein

This is a compound of silver and casein, containing about 4% of silver. It is used in ½–20% solutions.

Silver Citrate
Itrol

This is used as injections in 1–4000 to 1–1000 solutions as an antiseptic.

Silver Lactate
Actol

This is used in 1–300 to 1–500 solutions as an antiseptic

Cargentos.

This is a 50% albuminous solution of silver with casein. It is used as an antiseptic, in the form of tablets, vaginal tampons, dusting powder, ointment or suppositories.

Novargan (Silver Proteinate)
(Argenti Proteinas)

This is a compound of silver and albumin, containing 10% of silver. It is used as a urethral injection in 15% solutions.

Hegonon
Silver Nitrate Ammonia Albumose

This is an albumin silver preparation which contains 7% of silver. It is used in 1–6000 to 1–2000 solutions.

Icthargan (Silver Icthyolate)
Argenti Ichthyosulphonas

This contains 30% of silver and 15% of sulphur. It is used in 1–4000 to 3% solutions.

Sophol

This is a compound of silver and methylen nucleic acid. It is used an antiseptic and astringent in 2–5% solutions, in inflammations of the eyes.

ALUMINIUM AND ALUM

Aluminium is a light metal. The only salt of aluminium which is used in medicine, is the aluminium and potassium sulphate, or alum.

Uses

Alum is used principally as an astringent to contract mucous membranes.

It is used as a gargle in 1 to 5% solutions.

For douches, and as a lotion on the skin and other mucous membranes, it is used in ½–1% solutions.

Large doses of alum are occasionally used to produce vomiting.

Preparations

Alum (Alumen) — 0.3–1.0 gm. grs. v–xv

This is aluminium and potassium acetate. Alum is very injurious to the teeth, and when given internally, it should be given through a glass tube.

Dried Alum or Burnt Alum
(Alumen Exsiccatum)

This is alum which has been dried by heat. It absorbs moisture from the air. It is often combined with 1–5 parts of alcohol to harden the skin, and prevent bedsores.

The other salts of aluminium, such as the aluminium acetate and the aluminium chloride are used as antiseptics.

Aluminium Hydroxide (Aluminii Hydroxidum) — 0.3–1.0 gm. grs. v–xv

Aluminium Sulphate
(Aluminii Sulphas)

This is used only locally.

Solution of Aluminium Acetate
(Liquor Aluminii Acetas)
(Burrow's solution)

This is used in ½–2% solutions as an antiseptic.

New and Non-official Preparations

Alumnol
Alumini Naphtholsulphonas

This is used as an astringent and mild antiseptic, in ½–5% solutions, for dressings, gargles, douches, etc.

It is used as a caustic in 10–20% solutions.

LEAD (PLUMBUM)

Lead is a heavy metal which forms salts by combining with acids, many of which are used in medicine.

Chronic Lead Poisoning

Chronic lead poisoning is the most common form of poisoning by metals. It occurs particularly in workers who are forced to handle lead or its salts, such as white lead or type, continuously. Painters, type setters, plumbers and glaziers are frequently affected, the lead being absorbed from the skin, or from the stomach or intestines when it gets on the food from the hands.

Occasionally, lead poisoning results from drinking water coming through lead pipes, or eating canned food from cans soldered with lead, or from food adulterated with lead; such as cakes colored with chromate of lead, etc. It often occurs from inhaling lead fumes in a room painted with lead paint, and from the absorption of ointments or solutions applied to wounds or ulcers.

The symptoms appear very slowly and vary in different individuals. They result from the lead affecting the alimentary tract, the blood and the nerves.

Symptoms

Symptoms of the Alimentary Tract

1. Loss of appetite, nausea, metallic taste in the mouth and bad breath.

2. **"Lead line" on the gums.** This is a dark blue line of lead sulphide which is deposited at the junction of the gums and teeth. It may be absent if the teeth are kept very clean.

3. **"Lead Colic"** or painter's colic.

This is a very characteristic symptom, and usually appears suddenly. The patient complains of severe cramp-like abdominal pains, usually beginning around the navel, and lasting for several days, after which they disappear but soon return.

4. **Obstinate constipation.**
5. Occasionally vomiting.
6. Slow strong pulse.

Symptoms of the Blood

1. **Anaemia:** The blood cells often contain very small granules of lead.
2. Occasionally, abortion in pregnant women.

Symptoms of the Nerves

These symptoms appear later.

1. **Lead paralysis,** lead palsy or painter's palsy. The extensor muscles of both forearms usually become paralyzed, and the hands drop as a result of the contractions of the flexor muscles ("drop wrists"). Other muscles may be similarly affected.
2. Loss of sensation in areas of the skin.
3. Sharp, shooting or boring pains around the joints (arthralgia).
4. Rarely, blindness, from affection of the optic nerve.
5. **"Encephalopathia Saturnina."** These are various symptoms which occur very rarely, and are the result of the effect of lead on the brain.

Headache, dizziness, sleeplessness, deafness, stupor, weakness. Occasionally nausea, delirium, convulsions, hallucinations, etc.

In individuals who have had repeated attacks of lead poisoning, or who are exposed to lead continuously, the destruction of the cells in various organs of the body, and their replacement by connective or scar tissue, results in various chronic diseases. Thus, **chronic nephritis** often results from the destruction of many of the kidney cells.

Arteriosclerosis or hardening of the arteries, often results from the destruction of the cells of the blood vessel walls, and their replacement by connective tissue.

Treatment

1. Individuals who are continually exposed to lead or its salts, can often avoid poisonous symptoms by keeping their hands and nails scrupulously clean, especially before eating; to avoid getting the lead particles in the mouth. They should move the bowels regularly, best by epsom salts, and they should take dilute sulphuric acid in lemonade regularly. Their diet should contain plenty of milk.

The patients suffering from an attack of chronic lead poisoning should be treated in the following way:

1. The bowels should be moved regularly by magnesium or sodium sulphate, which also helps to neutralize the lead, forming lead sulphide, which is then excreted in the intestines.
2. Potassium iodide is given, which helps to eliminate the lead.
3. The lead colic is best controlled by atropine.
4. For the anaemia, iron is given.
5. The paralyses usually get well if carefully treated with electricity and massage.

Uses

Lead salts are used principally on ulcers and wounds, to contract the tissues, and to check bleeding.

The lead acetate is occasionally given to check diarrhoea.

Preparations

Lead Acetate **(Plumbi Acetas)** (Sugar of Lead)	0.06–0.3 gm.	grs. i–v

For Local Use:

Solution of Lead Subacetate
(Liquor Plumbi Subacetatis)
(Goulard's Extract)

This contains about 25% of lead subacetate. It should be diluted, about ℥1¼ being used to a pint of water.

Dilute Solution of Lead Subacetate
(Liquor Plumbi Subacetas Dilutum)

This contains ½ part of lead subacetate to 1000 c.c. of water.

Cerate of Lead Subacetate
(Ceratum Plumbi Subacetas)
(Goulard's Cerate)

This consists of lead subacetate solution, wool fat, white vaseline and camphor.

Lead Iodide
(Plumbi Iodidum)

Lead Plaster
(Emplastrum Plumbi)
(Diachylon Plaster)

This consists of lead oxide, soap and water.

Adhesive Plaster
(Emplastrum Adhaesivum)

This consists of rubber, lead plaster, and vaseline.

Soap Plaster
(Emplastrum Saponis)

This consists of soap, lead plaster and water.

Diachylon Ointment
(Unguentum Diachylon)

This consists of lead plaster, olive oil and oil of lavender.

ZINC (ZINCUM)

Zinc is a metal which forms salts, many of which are used in medicine.

Chronic Zinc Poisoning

Chronic zinc poisoning occasionally occurs among workers who handle zinc. It causes symptoms like those of lead poisoning.

Uses

Zinc sulphate is used to produce vomiting. The other zinc salts are used as astringents in various skin diseases and ulcers.

Preparations

Zinc Sulphate (as an emetic) 0.3–2.0 gms. grs. v–xxx
(Zinci Sulphas)

It is used as an eye wash in ¼–½% solutions and as an injection in gonorrhoea in 1–4% solutions.

Zinc Oxide
(Zinci Oxidum)

Zinc Oxide Ointment
(Unguentum Zinci Oxidum)

This contains 1 part of zinc oxide to 4 parts of benzoinated lard.

Precipitated Zinc Carbonate
(Zinci Carbonas Precipitatus)

Zinc Stearate
(Zinci Stearas)

This is used as a dusting powder on ulcers, and on various skin diseases.

Zinc Stearate Ointment
(Unguentum Zinci Stearas)

This contains 50% of zinc stearate.

Zinc Acetate
(Zinci Acetas)

This is used for injections and douches, in gonorrhoea.

Zinc Chloride
(Zinci Chloridum)

This is a white powder which is moulded into pencils.

It absorbs moisture from the air. It is used to destroy tissues (caustic action). It is an ingredient of many "cancer cures," and is applied as an ointment to destroy the cancerous tissue.

Solution of Zinc Chloride
(Liquor Zinci Chloridum)

This contains about 36% of zinc chloride, and is used as a disinfectant for sinks and toilets.

Burnett's disinfecting fluid

This contains about 13–30 c.c. of zinc chloride.

Zinc Iodide 0.06–0.12 gm. grs. i–ii
(Zinc Iodidum)

It is used locally as a caustic and to increase the growth of tissue.

Zinc Valerate 0.03–0.12 gm. grs. i–ii
(Zinci Valeras)

Zinc Bromide 0.03–0.12 gm. grs. i–ii
(Zinci Bromidum)

This is used to lessen nervousness and the twitchings of chorea and epilepsy.

COPPER (CUPRUM)

Copper is a metal, many salts of which are occasionally used as drugs.

Preparations

Copper Sulphate (blue vitriol or blue stone)
(Cupri Sulphas) as an astringent 0.015–0.12 gm. grs. $\frac{1}{4}$–ii
as an emetic 0.3 –0.6 gm. grs. v–x

It is used principally to contract the granulations which form in the eyelids in trachoma, an infectious disease of the eyelids.

It is also used to produce vomiting, as an astringent, and occasionally to destroy tissue (escharotic action).

Copper Citrate (not official)
(Cupricum Citricum)

This contains about 35% of copper. It is used as an astringent in 5–10% ointments.

BISMUTH (BISMUTHUM)

Bismuth is a crystalline metal. Many of its insoluble salts are used as medicines.

Poisonous Effects

Bismuth poisoning occasionally results when it is used for a long time; especially in the form of dressings. Such applications are more apt to cause poisonous symptoms than its internal administration.

Symptoms

The following symptoms, which resemble those of mercury poisoning appear very slowly:

1. Profuse flow of saliva.
2. Swelling of the gums, tongue and throat, often with destruction of the soft palate, and other portions of the mucous membrane of the mouth.
3. Vomiting and diarrhoea.
4. Albumin in the urine.

The symptoms usually disappear when the dressings are removed.

Uses

Bismuth salts are used as dusting powders on the skin, as astringents, as antiseptics and to promote healing of ulcers, and sinuses.

They are principally used to coat, protect and heal ulcers of the stomach, and as an astringent to check diarrhoea. They are often used to lessen nausea and vomiting. The stools usually turn black when bismuth is being given. This is due to the formation of bismuth sulphide.

Large quantities of bismuth pastes are often given to coat the mucous membranes of the oesophagus, stomach and intestines so as to enable an X-ray picture to be taken. The

bismuth is not penetrated by the X-rays, so that the organ containing the bismuth produces a dark shadow on the picture.

Preparations

Bismuth Subnitrate (Bismuthi Subnitras)	0.3–2.0 gms.	grs. v–xxx
Bismuth Subcarbonate (Bismuthi Subcarbonas)	0.3–2.0 gms.	grs. v–xxx
Bismuth and Ammonium Citrate (Bismuthi et Ammonii Citras)	0.12–0.3 gm.	grs. ii–v

This is more injurious to the tissues than the other preparations.

Bismuth Subgallate (Bismuthi Subgallas) (Dermatol)	0.3–1.3 gm.	grs. v–xx

New and Non-official Preparations

Bismuth Beta Naphtholate (Bismuthi Beta Naphtholas)	1.0–4.0 gms.	grs. xv–ʒi

This is used to check diarrhoea and as an intestinal antiseptic.

Bismuth Subcarbonate Preparations

Cremo Bismuth (Mistura Bismuthi Subcarbonatis Hydrati)	4.0–16.0 c.c.	ʒi–iv
Lac Bismo (Mistura Bismuthi)	4.0–16.0 c.c.	ʒi–iv

This is a mixture of bismuth hydroxide and bismuth subcarbonate.

Bismuth Subgallate Preparations

Airol (Bismuth Oxyiodogallate) (Bismuthi Iodosubgallas)

This is a combination of bismuth oxyiodide and gallic acid. It liberates iodine and is used as a local application to wounds, in 10% solutions in glycerin or in a 10 or 20% ointment.

Bismal (Bismuthi Methylen Digallas)	0.12–0.3 gm.	grs. ii–iv

Tannismuth 0.3–0.6 gm. grs. v–x
(Bismuthi Bitannas)

This contains about 17 to 21% of bismuth.

Bismon (Colloidal Bismuth Oxide) 0.5 gm. grs. viii

This is an albuminous solution containing 20% of bismuth.

Bismuth and Iron Citrate 0.3–0.6 gm. grs. v–x
(Bismuthi et Ferri Citras)

This is used for anaemia with gastric disturbances.

Crurin Purum
(Quinolin Bismuth Sulphocyanate)

This is used principally as an antiseptic in gonorrhoea and in ulcers of the leg in 1–200 solutions.

Bismuthal

This is a mixture of pepsin, hydrochloric acid, and bismuth.

Xeroform 1.0–3.0 gms. grs. xv–xlv
(Bismuthi Tribromiphenolas)

This is used principally as an antiseptic in ulcers of the leg, eczema, and as an intestinal antiseptic.

CERIUM OXALATE

Cerium oxalate is a salt of cerium, a crystalline metal, which resembles bismuth.

It is used to check vomiting; in pregnancy, sea-sickness, and in other conditions. Its mode of action is unknown.

Preparations

Cerium Oxalate 0.12–0.6 gm. grs. ii–x
(Cerii Oxalas)

BARIUM

Barium is a crystalline metal. The only salt commonly used in medicine is **barium sulphate.** A paste made with this salt is used to coat the stomach and intestines for taking X-ray pictures.

ALKALINE ASTRINGENTS

POTASSIUM CHLORATE

Potassium chlorate is a white crystalline powder having a cool salty taste. Its effects are due to the chlorate ion of the salt.

ACTION

Applied to the skin or mucous membranes, potassium chlorate contracts the tissues and acts as an astringent. It is therefore used to relieve inflammation of ulcerated surfaces or mucous membranes. It is frequently used as a gargle for sore throat and for ulcerations of the mouth following mercury poisoning. When absorbed, it increases the flow of urine, but it is seldom given for this effect, because of its poisonous action.

Potassium Chlorate Poisoning

This condition usually results when a potassium chlorate gargle is swallowed by mistake. The symptoms are due to the formation in the blood of methaemoglobin, a form of haemoglobin which does not combine with oxygen; and the red corpuscles are then unable to carry oxygen to the tissues. At the same time potassium chlorate injures the kidneys, producing symptoms of nephritis.

Symptoms

1. Abdominal pain.
2. Profuse vomiting and diarrhoea (the vomited matter contains bile or blood).
3. Scanty urine, which may contain haemoglobin and methaemoglobin (this gives the urine a transparent red color).
4. Jaundice, with small haemorrhages into the skin.
5. Cyanosis.
6. Muscular twitchings, convulsions.
7. Coma, collapse.

Treatment

The treatment consists in washing out the stomach and giving heart stimulants. The condition is best relieved, however, by removing a quantity of blood from a vein (and thereby a quantity of the methaemoglobin) and replacing it by an intravenous infusion of normal salt solution.

Preparations

Potassium Chlorate (**Potassii Chloras**) 0.06–0.3 gm. grs. i–v

It is used in 4–6% solutions as a gargle.

Troches of Potassium Chlorate. (**Trochisci Potassii Chloratis**) Each contains 0.3 gm. (grs. v)

Sodium Chlorate 0.06–0.3 gm. gr. i–v

This has the same action as potassium chlorate.

VEGETABLE OR ORGANIC ASTRINGENTS

Vegetable astringents are vegetable substances whose principal action is to contract the tissues and lessen the secretion of the mucous membranes. These effects are due to an organic acid, **tannic acid,** which all these substances contain.

TANNIC ACID OR TANNIN

Tannic acid is an organic acid which is found in a great many vegetable substances. It is obtained from powdered **nutgall** or **oak gall.** This is a vegetable growth produced in the bark of an oak tree; the **Quercus lusitannica,** dyers' oak, or gall oak. The growth results when a species of fly (the Cynips gallae tinctoriae) punctures the bark and deposits its eggs at the site of puncture.

There are various forms of tannic acid, depending on the plant from which it is derived; for example, **gallotannic acid,** from nutgall, **kinotannic acid,** from kino, **catechutannic acid** from catechu, etc.

Tannic acid is very closely related to gallic acid, which is tannic acid combined with water.

ACTION

The action of tannic acid is due to the coagulation of the proteins of the cells with which it comes in contact.

Local action: Applied to the skin, to a wounded surface or to an ulcer, tannic acid contracts the tissues by coagulating or hardening their cells. If applied to a bleeding point, it stops the bleeding by coagulating the proteins of the blood.

On mucous membranes: It checks the secretion, by contracting the cells.

Internal Action

In the mouth: It has a harsh bitter taste, and makes the mouth feel dry by contracting the mucous membrane.

In the stomach: It precipitates the protein of the food which is then not readily digested.

In the intestines: It contracts the mucous membrane, thereby checking its secretions and making it less susceptible to impulses that start peristalsis, which is then lessened, and the bowels are constipated.

Action after Absorption

Part of the tannic acid is changed in the intestine to gallic acid and to a salt, a tannate, which is absorbed into the blood, but which produces no effects on the tissues or organs of the body.

Excretion

Most of the tannic acid is destroyed in the body, but a very small amount is eliminated in the stools and urine as tannic acid, gallic acid or pyrogallic acid.

Poisonous Effects

Tannic acid is not a strong poison. Large doses, by the

destruction of many of the cells of the mucous membrane of the alimentary tract, often cause nausea, vomiting and diarrhoea.

Uses

Tannic acid preparations are used principally:

1. To check excessive secretion of the alimentary tract, as in diarrhoea.
2. To check excessive secretion and swelling of mucous membranes, as in the diseased condition of the mouth in mercury poisoning.
3. To prevent bed sores by hardening the skin.
4. As an antidote to various metallic and alkaloid poisons.
5. It is often given as an astringent irrigation in the colon and vagina.

Administration

For a local effect it should be given in the form of an ointment or a lotion.

For its effect in the stomach, it is best given in powder form.

For its effect in the intestines, it is best given in pill form.

Preparations

Tannic Acid **(Acidum Tannicum)**	0.12–0.6 gm.	grs. ii–x
Troches of Tannic Acid **(Trochisci Acidi Tannici)**	0.06–gm.	gr. i

For Local Use:

Glycerite of Tannic Acid
(Glyceritum Acidi Tannici)
This contains 20% of tannic acid.

Tannic Acid Ointment
(Unguentum Acidi Tannici)
This contains 20% of tannic acid.

Styptic Collodion
(Collodium Stypticum)
This contains 20% of tannic acid.

New and Non-official Preparations

The following preparations are not so apt to cause nausea and vomiting and are milder in their action.

Tannalbin 0.3–1.0 gm. grs. v–xv
Tannin Albuminate
(Albuminas Tannas)

This is a compound of tannic acid and albumin and is used to check diarrhoea. It is not dissolved in the stomach and acts only in the intestines.

Tannigen 0.2–0.6 gm. grs. iii–x
Tannyl Acetate
(Acidum Tannicum Diacetylicum)

This is used to check diarrhoea and acts in the intestine when it comes in contact with the intestinal juice.

Tannoform 0.25–0.5 gm. grs. iv–viii
(Tanninformaldehydum)

This is a compound of gallotannic acid with formaldehyde. It is an astringent and antiseptic and is used to check diarrhoea.

It is also used locally as a powder in 25% to 50% solutions or as a 10% ointment for eczema, profuse sweating, etc.

Tannopin or Tannon 0.3–0.5 gm. grs. v–viii
Hexamethylene Tetramine Tannin

This is used as an astringent and as an antiseptic in the intestines in chronic colitis, tuberculous enteritis, etc.

Protan 1.0–2.0 gms. grs. xv–xxx q. 2 h.
Tannin Nucleo Proteid

For children, 0.3–0.6 gm. grs. v–x q. h.

This is a compound of casein and tannic acid, containing 50% of tannic acid. It is used to check diarrhoea.

Tannacol 1.0–2.0 gms. grs. xv–xxx
Gelatine Tannate

This is used to check diarrhoea.

GALLIC ACID

Gallic acid is an organic acid which is usually made from tannic acid by its combination with water.

ACTION

Gallic acid does not coagulate albumins, and it has a milder action than tannic acid. It is more readily absorbed into the blood, and is only used to check excessive secretion of sweat, of bronchial mucus and to check bleeding from the lungs or kidneys, but it is not very effective.

Preparations

Gallic Acid (Acidum Gallicum)	0.3–2.0 gms.	grs. v–xxx

GALLOGEN (not official)

Gallogen, ellagic or benzoaric acid is an acid obtained from the pods of the **divi divi** plant or **Coesalpina coraria.**

It checks diarrhoea and contracts mucous membrane.

It is given in doses of 0.6–1.0 gm. (grs. v–xv)

VEGETABLE SUBSTANCES CONTAINING TANNIC OR GALLIC ACIDS

GALLA (NUTGALL)

Galla or nutgall is a growth which forms on the bark of the **Quercus infectoria,** or gall oak tree, by the punctures and the deposited eggs of a species of fly (Cynips tinctoria). Before the larvae are formed from the ova, the galls contain about 50% of tannic acid and smaller quantities of gallic acid.

ACTION

Nutgall contracts the tissues and checks the secretion of mucous membranes because of the tannic acid which it contains. It is little used except in the form of an ointment, as a local application for haemorrhoids.

Preparations

Tincture of Nutgall (**Tinctura Gallae**)	2.0–12.0 gms.	grs. xxx–℥iii
Nutgall Ointment (**Unguentum Gallae**)		
Gall and Opium Ointment (not official) (**Unguentum Gallae cum Opii**)		

This contains 7½% of opium.

GAMBIR

Gambir or pale catechu is an extract made from the leaves and twigs of **Ouraparia gambir,** an East Indian shrub. It is used as a powerful astringent; contracting the tissues and checking the secretions of mucous membranes, because of the tannic acids which it contains.

Preparations

Gambir	1.0 gm.	grs. xv
Compound Tincture of Gambir (**Tinctura Gambir Composita**)	4.0 c.c.	℥i
Troches of Gambir, each containing 0.06 gm. (**Trochisci Gambir**)		gr. i

This contains catechu, kino, krameria, cinnamon and nutmeg.

KRAMERIA (RHATANY)

Krameria is obtained from the roots of **Krameria triandra,** and of **Krameria Ixima,** para rhatany, and peruvian rhatany, two South American shrubs.

They are powerful astringents, contracting the tissues and checking the secretions, because of the tannic acid which they contain.

Preparations

Tincture of Krameria (**Tinctura Krameriae**)	2.0–8.0 c.c.	℥½–ii

KINO

Kino is the dried juice of the **Pterocarpus marsupium,** an East Indian tree.

It is a strong astringent, contracting tissues and checking the secretions of the mucous membranes, because of the tannic acid which it contains.

Preparations

Tincture of Kino (Tinctura Kino)	2.0–8.0 c.c.	ʒ½–ii

HAMAMELIS (WITCH HAZEL)

Hamamelis or witch hazel, is obtained from the leaves, bark and twigs of **Hamamelis virginiana,** an American plant. It contains tannic acid and a volatile oil.

It contracts the tissues and checks the secretions of mucous membranes. It is used to check bleeding and to lessen inflammations.

Preparations

Fluidextract of Witch Hazel Leaves (Fluidextractum Hamamelis Foliorum)	2.0 c.c.	m. xxx
Extract of Witch Hazel (Aqua Hamamelis)	8.0 c.c.	ʒii

This is a colorless alcoholic fluid made by distilling the leaves and twigs of witch hazel. It contains very little tannic acid and a volatile oil.

RUBUS (BLACKBERRY)

Rubus or blackberry is the bark of the roots of various species of the blackberry plant, such as **Rubus villosus, Rubus canadensis** and **Rubus trivialis.**

It is used as an astringent to contract the tissues and check the secretions of mucous membranes, because of the tannic acid which it contains.

Preparations

Fluidextract of Blackberry (Fluidextractum Rubi)	2.0–8.0 c.c.	$5\frac{1}{2}$–ii

Blackberry brandy is a common household remedy used to check diarrhoea.

RHUS GLABRA (SUMACH)

Rhus glabra is obtained from the fruit of **Sumach berries.** It contains tannic and mallic acids.

It is used as an astringent gargle, diluted in two parts of water, for sore throat and pharyngitis.

Preparations

Fluidextract of Rhus Glabra (Fluidextractum Rhois Glabrae)

ROSA GALLICA (RED ROSE PETALS)

Rosa gallica is made from red rose petals, gathered from the unopened buds.

It is used as a mild astringent and as a flavoring ingredient.

It usually comes in the form of a fluidextract, a honey, a syrup, and a confection, for flavoring purposes.

For local use, the following preparations are used:

Rose Water (Aqua Rosae)

Stronger Rose Water (Aqua Rosae Fortior)

Cold Cream or Rose Ointment (Unguentum Aqua Rosae)

CAMELLIA THEA (TEA PLANT)

Tea leaves contain large amounts of tannic acid. If they are boiled for a long time, and the leaves then squeezed out the resulting fluid contains large amounts of tannic acid.

Chamomile, jambul, and many of the vegetable substances used as bitters, contain large amounts of tannic acid, and have, therefore, an astringent action.

MYRRH (MYRRHA)

Myrrh is a gum resin obtained from the **Commiphera Myrrha,** an American tree. Its active principle is a resinous substance.

It contracts skin and mucous membranes and is slightly disinfectant. It increases the secretions and is said to increase menstruation.

It is used principally as an astringent; in inflammations of the gums as in mercury poisoning, and as an ingredient of many cathartics.

Tincture of Myrrh (Tinctura Myrrhae)	2.0–4.0 c.c.	$3\frac{1}{2}$–i

CHAPTER XXXII

ANTISEPTICS

Antiseptics or disinfectants are drugs which check the growth of bacteria (bacteria are very small unicellular microscopic organisms, many of which cause disease). They are divided into two groups: **germicides** and **antiseptics.**

Germicides or **disinfectants** are drugs which destroy bacteria. **Antiseptics** are drugs which check the growth of bacteria, usually by making the fluid in which they grow unfit for them to live in. **Deodorants** are drugs, most of which are also antiseptics, that destroy unpleasant odors.

The antiseptics, while checking the growth of bacteria, are also injurious to the tissue cells. They must therefore be used in solutions so weak that the drug will affect only the bacteria, and do little harm to the tissues. Antiseptics may be classified according to their practical use in the following way:

(a) **Local Antiseptics**

1. **Disinfectants for rooms.**
2. **Disinfectants for sinks, clothing, excreta, etc.**
3. **Antiseptics for the hands.**
4. **Antiseptics for the skin.**
5. **Antiseptics for wounds, ulcers, sinuses, etc.**
6. **Antiseptics for mucous membrane lined cavities.**

(b) **Antiseptics acting after absorption**

1. **Antiseptics acting on the lungs.**
2. **Genito-urinary antiseptics.**

DISINFECTANTS FOR ROOMS

FORMALDEHYDE

Formaldehyde is a gas obtained by oxidizing wood alcohol. A solution containing 40% of formaldehyde gas is called **formalin.**

ACTION

Antiseptic Action

Formaldehyde gas vigorously destroys bacteria (germicide) and checks their growth (antiseptic). It also neutralizes unpleasant odors (deodorant).

Local action: Applied to the skin or mucous membranes, formalin hardens the tissues and checks the growth of bacteria on the surface.

When formaldehyde gas is inhaled, it causes stinging and prickling sensations in the nose, with a profuse flow of mucus from the nose, a flow of tears from the eyes, secretion of saliva, and excessive coughing, with profuse expectoration.

Internal Action

Very small doses of formalin, when given internally, cause nausea and vomiting, lessen the digestion of food and make the pulse somewhat slower and weaker.

Poisonous Effects

Poisoning by large doses of formalin or formaldehyde gas occurs occasionally, and produces the following symptoms:

1. Nausea and vomiting.
2. Diarrhoea.
3. Shortness of breath and cyanosis (due to contracting the red blood cells and the formation of haematin in the blood).
4. Collapse, coma, convulsions and death.

The best antidote is ammonia water.

Uses

Formaldehyde gas is used principally to fumigate rooms and to disinfect clothing. It is generated in the following ways:

1. By heating a solution of formalin in the room; 150 c.c. of formalin are necessary to disinfect a room of 1000 cubic feet of space.

2. By heating paraform, a solid substance which liberates formaldehyde gas. There are numerous lamps on the market which liberate formaldehyde gas in this way.

3. By a specially constructed apparatus for generating formaldehyde gas. The gas is allowed to enter the room through a rubber tube which is inserted in the key-hole.

When disinfecting with formaldehyde gas, the cracks in the door should be stuffed with cotton and the room should be kept closed for 24 hours. The unpleasant odor is removed by sprinkling ammonia water about the room.

Formalin is used in 1–200 solutions to sterilize instruments. There are a number of instrument sterilizers on the market which generate formaldehyde gas and sterilize the instruments in this way. Formalin has also been used as a mouth wash and as a douche in 1–500 to 1–1000 solutions.

It is occasionally used as a preservative for milk and other foods. A 4% solution of formalin is used to preserve tissues for microscopic examination.

Preparations

Formalin
(Liquor Formaldehydi)

This contains 37% of formalhyde gas.

Paraform or Paraformaldehyde
(Trioxymethylene)

This is a solid substance which liberates formaldehyde gas on heating. It is used locally to destroy warts and also internally as an antiseptic.

There are a number of other preparations which liberate formaldehyde gas in the body; they will be described under their particular use.

SULPHUR DIOXIDE

Sulphur dioxide or sulphurous acid is a gas which is formed when sulphur is burned. It is one of the oldest disinfectants in medicine; being used since 1771. It is an excellent disinfectant for rooms; but it is apt to injure clothing, linens, carpets, etc.

Uses

Sulphur dioxide is formed when sulphur candles or sulphur masses are burnt in the room. The sulphur should be placed in a metal or porcelain dish placed in a basin of water, and the sulphur should then be burned. All cracks and key-holes in the room should be tightly closed.

CHLORINE (CHLORUM)

Chlorine is an element which occurs in the form of a greenish yellow gas. It is obtained from sea salt, and a number of its compounds are used as disinfectants.

Chlorine, bromine, and iodine, are three closely related elements called halogens, since they are all obtained from the sea; thus; chlorine from sea salt, bromine from sea water, and iodine from sea weeds.

ACTION

Antiseptic action

Chlorine gas is one of the most efficient disinfectants known; especially when it is used in the presence of moisture. The chlorine combines with the hydrogen of the water, thus setting oxygen free. The oxygen then destroys the bacteria. A 0.3% solution of chlorine will destroy even the spores of bacteria in about three hours. Chlorine also removes obnoxious odors very readily (deodorant).

Action on the Body

Local action: Concentrated solutions of chlorine gas redden the skin and produce blisters if the solution is pre-

vented from evaporating. **On mucous membranes** it increases the secretions.

Internal Action

In the mouth chlorine usually causes profuse secretion of saliva. **In the stomach and intestines** it increases the secretions. Inhalation of chlorine gas usually makes the patient cough and increases the secretions of the bronchi.

Poisonous Effects

If large quantities of chlorine solutions are swallowed the following effects are produced:

1. Redness and destruction of the tissues around the mouth.
2. Abdominal pain.
3. Nausea and vomiting.
4. Collapse (cold moist skin, rapid thready pulse, slow and shallow breathing.)

These symptoms are due to the formation of excessive amounts of hydrochloric acid in the stomach.

If the gas is inhaled, the patient has violent coughing; often with bloody expectoration.

The symptoms should be treated with alkalies, such as sodium bicarbonate; for the pain, morphine should be given; as well as albumins, milk, or flour to protect the mucous membrane of the stomach.

Uses

Chlorine is used principally to disinfect stools and urine. It is used in the form of chlorinated lime; which liberates chlorine gas. It has a special advantage in removing foul odors. Concentrated chlorine gas, liberated by a specially constructed generator is used to disinfect rooms. It is very efficient; but it bleaches various dyed materials. It is prepared by placing a dish containing equal parts of black oxide of manganese and salt in the center of the room. To this is added one tablespoonful of strong sulphuric acid diluted one third. Enough chlorine gas will thus be formed to disinfect the room.

Preparations

Chlorine water
(Liquor chlori compositae)

This is a solution containing 4 parts of chlorine gas to 1000 c.c. of water.

It should be freshly prepared, since old preparations may contain hydrochloric acid.

Chlorinated Lime or Bleaching Powder
(Calx Chlorinata)

This is a grayish white powder containing 35% of chlorine gas when fresh. It is sometimes erroneously called chloride of lime. A fresh powder forms a clear solution; otherwise the solution becomes turbid.

Solution of Chlorinated Soda 0.6–1.3 c.c. m. x–xx
(Liquor Sodae Chlorinatae)
(Labarracque's or Javelle's Solution)

This is a solution made from chlorinated lime and sodium carbonate. It contains sodium hypochlorite and sodium chloride. It liberates about 2½% of chlorine gas and is used for cleaning medicine droppers, douche nozzles and other small utensils. It is especially valuable to remove stains. It is occasionally given internally in half a tumbler of warm milk.

BROMINE (BROMUM)

Bromine is a liquid element obtained from sea water. Its action is similar to that of chlorine with the following differences:

1. It is more destructive to the tissues. It is occasionally used to cauterize infected wounds (escharotic action).
2. When given internally in the form of bromides it lessens the activity of the brain (see Bromides).

DISINFECTANTS FOR SINKS, CLOTHING, ETC.

For this purpose **formalin** is occasionally used in 10% solutions.

CARBOLIC ACID (PHENOL)

Carbolic acid or phenol is a crystalline solid substance which readily absorbs moisture from the air. It is made by distilling coal tar; it dissolves readily in water, alcohol or glycerine.

Antiseptic Action

Carbolic acid destroys all living tissues (protoplasm). In weak solutions (2–5%) it checks the growth of all bacteria except their spores. It is the most efficient antiseptic known.

Action on the Body

Local action: Concentrated solutions destroy the skin by hardening or coagulating the proteins of the cells. This forms a white crust which becomes red and shiny. The crust falls off in a few days, leaving a light brown area. Weak solutions (2–5%) produce a feeling of warmth and tingling followed by numbness and contraction of the skin. Applied to wounds, carbolic acid causes pain and redness with the formation of a white pellicle of coagulated albumin.

Local applications of carbolic acid solutions, if prevented from evaporating, as when applied in the form of a wet dressing, often destroy the skin and deeper tissues (gangrene). Gangrene of a finger or other part of the body has occasionally resulted from continued use of such wet dressings. For this reason its use as a wet dressing has been given up. **On mucous membranes:** carbolic acid checks the growth of bacteria if applied in weak solutions.

Strong solutions, if applied for some time, destroy the tissues; and if the area over which it is applied is extensive, collapse may result.

Internal Action

Carbolic acid is never given internally. When taken with suicidal intent it produces effects after absorption (see poisonous effects). There are, however, a number of drugs, such as salol, which form small amounts of carbolic acid

in the intestines. These then act as antiseptics, checking the growth of bacteria in the intestines. In this way they lessen the decomposition of the waste products in the intestines (putrefaction).

Action after Absorption

When a small quantity of carbolic acid is absorbed, either from wet dressings applied to wounds or when formed in the intestine, it occasionally produces the following effects:

1. It increases the secretion of saliva.
2. It increases the flow of urine. The urine has a characteristic smoky dark green color which soon turns brown or even black.
3. Occasionally, the patient becomes somewhat drowsy, due to the lessened action of the brain. (depression).
4. The breathing becomes somewhat deeper and faster and the pulse slower and weaker.

Excretion

In cases where a small quantity of carbolic acid is absorbed, it is rapidly eliminated by the urine in the form of various compounds which give the urine a characteristic dark green color.

Poisonous Effects

Acute poisoning from carbolic acid is not an infrequent occurrence as a result of attempts at suicide, since it is the easiest poison to obtain.

Symptoms

If a large quantity of carbolic acid is taken, the patient becomes unconscious and dies within a few minutes from a sudden paralysis of the heart and respiration. This is probably due to the sudden destruction of a large area of mucous membrane and the resulting collapse.

If smaller quantities are taken, the following symptoms appear in the order of their onset: Some of these symptoms also occasionally result from the continued use of wet dressings.

1. Pain around the mouth and lips, and in the stomach. The lips and mouth are blanched.

2. Nausea and vomiting, the vomited matter containing mucus.

3. Headache, dizziness, and noises in the ears.

4. Drowsiness and depression.

5. Collapse: rapid thready pulse, cold moist skin, the pulse falls to 40 or 50 per minute, the breathing becomes irregular, often snoring in character. Toward the end, the breathing becomes difficult and shallow, sometimes gasping, and because of the shallow breathing, the patient becomes cyanotic.

6. Finally, the patient goes into stupor, and coma, and may die from paralysis of the respiration, in about one to ten hours.

Occasionally, convulsions occur just before death. A very characteristic symptom of carbolic acid poisoning is the dark green color of the urine, and the odor of the acid on the breath. The fatal dose is usually about ʒi–iv.

Treatment

1. Wash out the stomach with 20% alcohol.

2. The following salts are given as antidotes: about ʒi of one of the salts dissolved in a glass of water.

Magnesium sulphate (Epsom salts).
Sodium sulphate (Glauber's salts).
Lime water and milk.

They form sulphocarbolates; harmless salts of carbolic acid.

3. Give alcohol in the form of whiskey or brandy, or even in 20% solutions. The alcohol neutralizes the carbolic acid; its mode of action is unknown. (A carbolic acid burn is readily neutralized, if followed immediately by the application of alcohol). The stomach should be washed out, however, as the solution is readily absorbed.

4. Protect the mucous membrane of the mouth and œsophagus with albumin water, flaxseed tea or milk. Do *not* give oils or glycerine as they help to absorb the carbolic acid.

5. The collapse is treated with heart stimulants such as caffeine, strychnine, atropine, etc., and the patient should be kept warm.

Uses

Carbolic acid was the first substance used as an antiseptic. It was formerly sprayed in operating rooms to disinfect the air, since most infections were supposed to come from the air. Later knowledge of the nature of infections has proven the worthlessness of this use. At the present time carbolic acid is used:

1. To disinfect sinks, toilets, sputum cups, clothing, etc., in 2–5% solutions. The articles must be soaked in carbolic acid for a half to several hours.

2. To disinfect the sick room by washing the walls and furniture. The fumes are often inhaled from such use and cause slight poisonous symptoms.

3. It is occasionally given internally to check vomiting, and as an intestinal antiseptic to check fermentation in the intestines.

Preparations

Carbolic Acid (Phenol): For internal use 0.03–0.2 gm. grs. ½–iii

This comes in crystals which readily take up water (hygroscopic). It is used principally for its destructive action on tissues (corrosive action).

Liquid Carbolic Acid (Phenol Liquefactum): For internal use 0.06–0.2 c.c. m. i–iii

This contains 90% of carbolic acid.

Glycerite of Phenol (Glyceritum Phenolis) 0.12–0.3 c.c. m. ii–v

This contains 20% of phenol dissolved in glycerine.

Carbolic Acid Ointment (Unguentum Phenolis)

This contains 5% of carbolic acid.

As an antiseptic carbolic acid is used in 2–5% solutions.

Carbolic Acid Derivatives

Cresols

There are a number of oily substances which are exten-

sively used as antiseptics, and are chemically closely related to carbolic acid.

They are oily solutions, which do not dissolve readily in water and are used as emulsions or in soapy solutions. The antiseptic, physiological and poisonous actions of all of them are like that of carbolic acid.

Preparations

Cresol 0.06 c.c. m. i

This is a mixture of all the cresols.

Compound Solution of Cresol
(Liquor Cresolis Compositus)

This is a 50% solution of cresol in soap solution. It is used in dilute solutions as a disinfectant.

New and Non-official Preparations

Tricresol

This is a mixture of all the three cresols.

Kresamine
(Ethylenediamine Tricresol)

This contains 25% of tricresol and is used as an antiseptic like phenol and as an ointment for skin diseases.

Creolin

This is an emulsion of cresol. It is used in 1–5% solutions to disinfect sinks, excreta, toilets, etc. It is also used in $\frac{1}{2}$ to 1% solutions for vaginal douches, and for bladder irrigations. Creolin solutions must be made up with warm water.

Lysol

This is a 50% solution of cresols dissolved in soap. It forms a frothy solution in water and is used for douches and other irrigations in $\frac{1}{2}$ to 1% solutions.

Lysoform

This is a combination of lysol and formaldehyde which is used as a disinfectant in 5 to 10% solutions.

Solveol
Solutol

These are solutions of cresols which have been made soluble by the addition of salts.

OTHER ANTISEPTICS FOR CLOTHING AND EXCRETA

ZINC SULPHATE

This acts as a disinfectant by precipitating the proteins of the bacteria. For this purpose the following solution is used:

Zinc sulphate	60.0 gms.	℥ii
Sodium chloride	120.0 gms.	℥iv

These salts are dissolved in one gallon of water, and the clothes are soaked in this solution for 4–6 hours.

Zinc chloride is occasionally used as a disinfectant, but it is not very reliable and is therefore not frequently used.

IRON SULPHATE

This acts as an antiseptic by precipitating the proteins of the bacteria. It acts more readily when the bacteria occur together with organic matter, such as pus or blood. It is used principally to disinfect the stools, using an equal part of the solution.

ANTISEPTICS USED TO DISINFECT THE HANDS

The following antiseptics are used principally to disinfect the hands of the surgeon or nurse when performing or assisting at an operation, or when dressing wounds. To obtain the maximum antiseptic action, the hands should be kept in the solution for about five to fifteen minutes.

Bichloride of Mercury or **Corrosive Sublimate**
(Hydrargyri Chloridum Corrosivum)

This is used as an antiseptic in solutions of 1–10,000 to

1–1000. Continued use of bichloride is apt to be injurious to the skin, causing redness and itching. The solution should always be fresh, as the bichloride combines with the bacteria so that old solutions become inactive. It cannot be used to disinfect instruments as it turns them black (corrodes).

Mercuric Cyanide
(Hydrargyri Cyanidum)

This is used in solutions of 1–4000 to 1–2000 like bichloride, but it does not corrode instruments and does not injure the skin.

Mercury Oxycyanide
(Hydrargyri Oxycyanidum)

This is used like bichloride of mercury. It has a greater antiseptic power, is less injurious to the tissues, and does not corrode instruments. It is used in 1–5000 solutions.

Sublamine
(Mercuric Sulphate Ethylendiamine)

This is similar to calomel. It is used in solutions of 1–1000 to disinfect the hands, and for irrigations. It is also given in 3–4% solutions intramuscularly for syphilis.

Alcohol

This is used in 50–70% solutions as a very efficient antiseptic for the hands. Stronger solutions are not as active because they harden the capsules of the bacteria and do not penetrate the bacteria themselves.

"Lime and Soda"

A very common method of disinfecting the hands is by rubbing chlorinated lime and sodium carbonate together in the hands. Chlorine gas is liberated in this way, which disinfects the hands.

ANTISEPTICS USED TO DISINFECT THE SKIN

IODINE (IODUM)

Iodine is a non-metallic element obtained from the ashes of sea weeds. Iodine itself is not used in medicine, but various solutions and compounds of it are frequently employed.

Antiseptic Action

Iodine checks the growth of bacteria, having a marked disinfectant action. It has been used very extensively for the last few years to disinfect the skin in preparation for operations. It is of especial value for this purpose since it also contracts and hardens the skin so that bacteria cannot be carried from the skin to the deeper tissues of the wound. It should not be applied in a concentrated solution or when the skin is moist, as it is then apt to cause blisters or even to destroy the deeper tissues.

Action on the Body

Local action: Iodine stains the skin a dark brown color and makes it red and warm. Strong solutions cause blisters and may even destroy the skin. It is also slightly absorbed from the skin.

On mucous membranes: It produces redness, smarting and increases the secretions.

Internal Action

When taken internally, it causes nausea and occasionally vomiting and diarrhoea. It is readily absorbed from the stomach in a few minutes.

Action after Absorption

The iodine combines in the blood with the sodium or potassium salts; thus forming iodides. The effects then produced are like those of the iodides. (See page 510.) They increase the secretion of all the secretory glands, such as the saliva, the mucous from the nose and bronchi. They also increase

the absorption of newly formed tissues (they are often given to reduce enlarged lymph nodes). At the same time, by increasing the secretion of the thyroid gland, the pulse becomes more rapid and the patient becomes quite nervous.

Excretion

Iodine is eliminated from the body in a few minutes; by all the secretions as well as by the kidneys.

Poisonous Effects

Acute poisoning from iodine occurs very rarely; usually from the injection of iodine into cysts in order to obliterate them, and occasionally from iodine taken with suicidal intent.

Symptoms

1. Nausea and continuous vomiting. The vomited matter contains iodine which turns blue if starch is also present.
2. Diarrhoea.
3. Cyanosis.
4. Collapse, rapid thready pulse, cold moist skin, slow shallow breathing and dilated pupils. Death usually occurs in a few days.

Treatment

Give boiled starch as an antidote. Protect the mucous membrane with albumin water, milk or other protecting drinks; treat the collapse with heart stimulants; such as caffeine, atropine, strychnine, etc.

Chronic Poisoning "Iodism"

Continued use of iodine often causes the following symptoms:

1. Skin eruptions, beginning at the site of application; consisting of areas of redness.
2. Increased secretion of mucous from the nose and bronchi.
3. Rapid pulse.
4. Nervousness and tremors of the fingers.

The symptoms usually disappear when the iodine applications are stopped.

Preparations

Tincture of Iodine (Tinctura Iodi) 0.06–0.3 c.c. m. i–v

This contains 7% of iodine and 5% of potassium iodide in alcohol.

Compound Iodine Solution (Liquor Iodi Compositus) (Lugol's Solution) 0.2–0.8 c.c. m. iii–xii

This contains 5% of iodine dissolved in 10% of potassium iodide solution.

Iodine Ointment (Unguentum Iodi)

This contains 4% of iodine.

Sulphur Iodide (Sulphuris Iodidum)

This is a mixture of iodine and sulphur.

Losophan (Not official)

This is a preparation containing 78% of iodine. It is used as a powder or in 10–20% solutions.

SULPHUR

Sulphur is an element which occurs in the form of a yellow powder. It is found in volcanoes and also as compounds of various metals forming sulphides (a sulphide is a compound of sulphur with another element or with a metal). The action of sulphur is due to the sulphides which it forms in the body.

ACTION

Local action: Applied to the skin it slightly checks the growth of bacteria and destroys parasites (parasiticide). It stains silver objects black, by forming silver sulphide.

Internal Action

When taken internally, the sulphides which it forms in the intestines increase the secretions; producing mild movements of the bowels. It is eliminated from the body as sulphides by the expired air; to which it gives a very foul odor, and also by the stools.

Poisonous Effects

Continued use of sulphur often causes anaemia, great wasting and tremors of the muscles.

Preparations

Sulphur Ointment
(Unguentum Sulphuris)

This contains 15% of sublimed sulphur with benzoin and lard.

Liver of Sulphur
(Potassa Sulphurata)

This is a preparation of sulphur which is often used in ointments and baths in doses of ʒi–vi of sulphur to a gallon of water. This substance is very destructive to tissues (corrosive).

Thilanin (Not official)

This is a mixture of lanolin and sulphur containing about 5% of sulphur. For other preparations of sulphur used as cathartics see page 100.

ICHTHYOL (Not official)

Ichthyol is a substance obtained from a peculiar bituminous mineral found in the Tyrol. It is formed by the deposits of fossil fish and contains about 10% of sulphur.

ACTION

Applied to the skin ichthyol is slightly antiseptic and causes redness. **When given internally it acts as an antisep-**

tic in the intestines. In large doses it is apt to cause slight nausea and vomiting. The same effects occasionally result when it is absorbed from the skin.

Ichthyol is used as an antiseptic and mild irritant in various skin affections.

Preparations

Ichthyol 0.2–2.0 c.c. m. iii–xxx
(Ammonii Ichthyosulphonas)

This is a reddish brown substance which dissolves readily in water. It is used in the form of watery solutions or ointments in from 1–20% solutions.

Sodium Ichthyol
(Sodii Ichthyosulphonas)

Calcium Ichthyol
(Calcii Ichthyosulphonas)

Ichthargan
(Argenti Ichthyosulphonas)

This contains 30% of metallic silver and 15% of sulphur It combines the action of both.

Ferrichthyol	1.0–2.0 gms.	grs. xv–xxx
Ichthalbin	0.6–1.3 gms.	grs. x–xx
(Ichthyol Albuminate)		

Ichthoform	0.6–2.0 gms.	grs. x–xxx
(Ichthyol Formaldehyde)		

This is given in gruel or cocoa as an intestinal antiseptic. It is also used to disinfect rooms, for irrigations and in douches.

THIOL (THIOLUM) (Not official)

Thiol is an artificial substance formed by the action of sulphur on the tar obtained from brown coal. Its action is like that of ichthyol. It is used in the treatment of burns.

Preparations

Dry Thiol
(Thiol Siccum)

This contains 8% of sulphur and is used as a dusting powder on wounds.

Liquid Thiol
(Thiol Liquidum)

This contains about 2% of sulphur and is used in various skin diseases.

Tumenol
(Tumenol Venale) } **Tumenol Ammonium**

These are artificial preparations made from the same mineral as ichthyol. They act like ichthyol and are used in solutions of from 5–20%.

RESORCIN

Resorcin or resorcinol is a chemical substance made from carbolic acid.

ACTION

The action of resorcin is like that of carbolic acid.

Local action: Applied to the skin it checks the growth of bacteria; acting as an antiseptic and disinfectant.

When given internally it produces the following effects:

1. It checks the growth of bacteria in the stomach and intestines.
2. It reduces temperature, and increases perspiration.
3. It makes the pulse slower.

Overdoses of resorcin produce the same poisonous effects that result from carbolic acid poisoning. (See page 588.)

Uses

Resorcin is used principally as an antiseptic in skin diseases, such as dandruff, baldness, etc. It is occasionally used as an intestinal antiseptic and to reduce temperature.

Preparations

Resorcinol (**Metadioxybenzol**)	0.3–0.6 gms.	grs. v–x

Externally this is used in 5–10% solutions.

Euresol (Not official)
(**Resorcin Monacetate**)

This acts like resorcin and is especially valuable in dandruff and baldness.

Pyrocatechin and **Hydroquinone** are the derivatives of carbolic acid which are rarely used in medicine.

PYROGALLOL

Pyrogallol or pyrogallic acid is a light crystalline substance made by heating gallic acid.

ACTION

The action of pyrogallol is similar to that of carbolic acid.

Applied to the skin or mucous membranes it checks the growth of bacteria, acting as an antiseptic; it destroys parasites and produces redness of the skin. It usually stains the skin or clothing a dark brown color.

Pyrogallol is occasionally absorbed from the skin and produces poisonous symptoms which resemble those of carbolic acid poisoning. (See page 587.)

Preparations

Pyrogallol
(**Pyrogallic Acid**)

This is used in the form of 5–20% ointments.

TAR (PIX LIQUIDA)

Tar is a black, semi-solid, sticky substance of a peculiar characteristic odor and taste. It is an oleoresin, obtained by the destructive distillation of the wood of various species of the pine tree, especially the **Pinus palustris** or the pine tree of North Carolina. (Destructive distillation is a process of

decomposition by heating. Some of the decomposed products are vapors, and become fluid or semisolid when passed into a cold receptacle.)

When tar is distilled, it forms the oil of tar, an oily liquid, and a solid black residue called pitch.

Tar consists of a number of substances; the following are the most important ones: creosote, pyroligneous acid, wood alcohol, and a number of other compounds.

ACTION

Local action: Tar is used principally as an antiseptic and irritant in skin diseases. It usually causes considerable inflammation. When the skin becomes severely inflamed, the fact should be reported to the physician. Tar should be applied with great care to the face and parts of the body where the skin is tender.

Internally, it is principally used as a stimulating expectorant, especially in chronic bronchitis. It is occasionally used to destroy intestinal worms, and as an intestinal antiseptic.

Preparations

Oil of Tar (**Oleum Picis Liquidae**)	0.06–0.3 c.c.	m. i–v
Syrup of Tar (**Syrupus Picis Liquidae**)	4.0–12.0 c.c.	ʒi–iii

This contains 7½% of tar.

Tar Ointment (**Unguentum Picis Liquidae**)

This contains 50% of tar.

OIL OF CADE

This is a substance made by destructive distillation of Juniper wood. It is used as an antiseptic and irritant in skin diseases.

New and Non-official Antiseptics

Antiformin

This is a strongly alkaline solution of sodium hypochlorite.

It rapidly dissolves the bodies of all bacteria, except the tubercle bacilli. It dissolves all secretions such as sputum and also destroys unpleasant odors. It is therefore a disinfectant, antiseptic and deodorant. It is said to be a stronger disinfectant than carbolic acid. It is also used in testing the sputum and other secretions, for tubercle bacilli. Antiformin is used externally in 2–10% solutions, and as a spray in 1–1000 solutions.

Anthrasol

This is a colorless coal tar which has been freed from pitch, coloring matter and other substances and is then mixed with juniper tar. It is used as an antiseptic for the skin, to destroy parasites and to soothe the skin. It is usually given in ointments of 5–30% in various skin diseases.

Afridol

This is a compound of mercury used to disinfect the hands, as a surgical antiseptic, and for various skin diseases. It usually comes in the form of a soap containing about 4% of the drug.

Chinosol

Chinosol or oxyquinoline sulphate is an artificial chemical substance which comes in the form of a yellow powder. It is used as an antiseptic for the skin, as a nasal spray, as a gargle and as a douche in 1–5000 to 1–1000 solutions.

Alumnol
(Alumini Naphtholsulphonas)

This is used in ¼–1% solutions as a surgical antiseptic, as a gargle and for douches.

Phenoco

This is a mixture of coal tar creosote and other coal tar derivatives in soap solution. It is used as a surgical antiseptic in 1–5% solutions.

Veroform

This is a liquid obtained by dissolving formaldehyde gas in a solution of soap. It contains 6–20% formaldehyde gas and is used as a surgical antiseptic.

ANTISEPTICS USED AS DRESSINGS FOR WOUNDS, ULCERS AND SINUSES

The following antiseptics are the ones most frequently used as wet dressings or to irrigate wounds, ulcers and sinuses.

Corrosive Sublimate (Bichloride of Mercury) — In 1–10,000 to 1–1000 solutions

Aluminium Acetate Solution (Burow's Solution)

This is used in $\frac{1}{2}$ to 2% solutions and is especially valuable when it is desired to harden the tissues.

Boro Salicyl Solution (Thiersch Solution) (See page 523).

DAKIN'S SOLUTION

Dakin's solution is a specially prepared solution of sodium hypochlorite. Sodium hypochlorite has long been used as an antiseptic in the form of Labarracque's or Javelle's solution. Dakin's solution is prepared in a very special way. It must contain exactly 0.45–0.50% of sodium hypochlorite. If the percentage of hypochlorite is less the solution is inactive; while if it contains more than this percentage the solution is very irritating. Furthermore the solution must be absolutely neutral in reaction when tested with phenolphthalein otherwise the solution cannot be used.

ACTION

Dakin's solution is one of the best antiseptics now in use. The employment of this substance according to the method devised by Dr. Carrel has practically revolutionized the treatment of wounds in the World War. It is about fifteen times as strong in its antiseptic power as carbolic acid; yet it does not injure the young growing tissue cells and consequently it does not retard healing as do most other antiseptics.

Dakin's solution produces its effect by liberating free

chlorine which combines with the NH radical of the proteins in the wound thus forming new compounds called **chloramins** which are the active antiseptic substances. At the same time they increase the flow of lymph from the wound surfaces.

Carrel Dakin Method of Treatment of Wounds

The practical method for using Dakin's solution in the treatment of wounds was originally devised by Dr. Alexis Carrel of the Rockefeller Institute.

A fresh, exactly neutral solution is allowed to flow into the wound by means of a specially constructed apparatus. This apparatus consists of a graduated bottle and a long tube which terminates in a number of fine rubber tubes with small holes in their sides. These terminal tubes are placed in the wound in such a position that the fluid runs downward but in contact with every part of the wound, after being wrapped around with small pieces of gauze so as to keep them in place. Small pieces of gauze are placed between the tubes. About every two hours enough fluid is allowed to run through the tubes to just fill the wound. This intermittent flow is essential because the solution is absorbed by the tissues and new fluid is then required.

Dakin's solution dissolves the clots and dead tissue in the wound. It is therefore essential that all the blood vessels be tied before the treatment is begun; since the dissolving of a clot over an open blood vessel may cause a haemorrhage.

Since Dakin's solution is irritating to the skin the skin should be covered with sterile vaseline for protection. If the patient complains of pain, it means that the solution is flowing under too great pressure or that it has not been properly prepared.

Preparations

Dakin's Solution (Surgical solution of chlorinated soda)

This is a specially prepared exactly neutral solution of sodium hypochlorite.

Chloramine T (Chlorazene)

This is a sodium compound of a complex organic chlorine preparation. It is four times as strong as phenol. It acts like Dakin's solution; it is more stable, lasts longer but it has not the dissolving power of Dakin's solution. It is used in 1 or 2% solutions applied in the same manner as Dakin's solution. It is also used as a mouth wash and as an irrigation for the urethra, bladder and uterus.

Chloramine B

This is a sodium preparation of a complex organic chlorine preparation (Sodium benzenesulphochloramene). It is used in the same manner and it has the same effects as chloramine T.

Chlorcosane

This is a thick liquid consisting of liquid paraffin containing chlorine in a stable, non-active combination. This substance is used merely as a solvent for dichloramine T so as to prevent the chlorine combining with the oil (which is already combined with chlorine) which would otherwise prevent its action. It is used as a spray.

Holazone

This is a complex organic chlorine compound. It acts like Dakin's solution but it does not decompose readily. It is used in tablets of 0.004–0.008 gm. together with sodium borate and sodium chloride. Each tablet is dissolved in a liter of water.

Dichloramine T

This is an organic chlorine compound prepared by Dakin. It does not dissolve very readily in water. In wounds it is used in 10 or 15% solutions. It is used as a spray for the nose and throat and in wounds; usually dissolved in chlorcosane, or in chlorinated paraffin or in chlorinated eucalyptol.

OXIDIZING DISINFECTANTS

The following drugs act as disinfectants by liberating oxygen when they come in contact with organic matter.

HYDROGEN PEROXIDE

Hydrogen peroxide or hydrogen dioxide is a liquid which is a chemical compound of equal parts of hydrogen and oxygen. A 3% solution of hydrogen peroxide is used in medicine.

ACTION

Local action: Hydrogen peroxide solution is decomposed when it comes in contact with organic matter, such as pus or blood. It then yields bubbles of oxygen. The oxygen then destroys the bacteria with which it comes in contact and disinfects the tissues. At the same time it helps to loosen the membranes and pieces of dead tissue (sloughs). The effect of the peroxide wears off very rapidly. The more pus or dead tissue present in the wound, the more oxygen is liberated.

It is used principally to irrigate wounds or sinuses containing pus. It is also used in infections in the mouth and throat and other mucous membrane lined cavities.

Hydrogen peroxide, together with sodium bicarbonate is used to bleach the hair.

Preparations

Hydrogen Dioxide
(Aqua H drogeni Dioxidi)

This contains about 3% of hydrogen peroxide and forms about ten volumes of oxygen for every volume of the peroxide used.

New and Non-official Preparations

The following drugs are compounds of hydrogen peroxide made by replacing the hydrogen by a metal. They act as disinfectants and antiseptics like hydrogen peroxide, by liberating oxygen. Their effect is said to be more lasting,

however, since the oxygen is given off very slowly. They are often used internally as intestinal antiseptics.

Calcium Peroxide (Calcii Peroxidatum)	0.06–0.3 gm.	grs. i–v
Magnesium Peroxide (Magnesii Peroxidatum)	0.25–0.5 gm.	grs. iv–viii

Sodium Peroxide (Sodii Peroxidatum)

This is only used externally in the form of a paste or soap in skin diseases like acne.

Oxone: This is a preparation of fused sodium peroxide.

Strontium Peroxide (Strontium Peroxidatum)

Zinc Peroxide (Zincum Peroxidatum)

These are used externally in the form of gauze, as a dusting powder or a 10% ointment. Peroxide zinc soap is a soap containing 10% of zinc peroxide.

Acetozone (Succinic Dioxide)
Alphozone

These are artificial chemical substances which act like hydrogen peroxide. They are used in 1–3000 to 1–1000 solutions on wounds, for instruments and for douches.

POTASSIUM PERMANGANATE

Potassium permanganate is a salt of manganese.

When potassium permanganate comes in contact with organic substances, such as the albumins of the tissues, it combines with the albumins and liberates oxygen, which destroys bacteria; acting as an antiseptic and disinfectant. When it has combined with the albumins, it no longer liberates oxygen and is therefore not effectual.

It is used in poison ivy rash. In India it is used for snake bite.

Preparations

Potassium Permanganate (Potassii Permanganas)	0.06–0.2 gm.	gr. i–iii

For the hands and wounds it is used in 1–3% solutions. It is also used as a gargle and for douches in 1–1000 to 1% solution.

Zinc Permanganate (Zinci Permanganas)

This acts like potassium permanganate and is principally used as an injection in gonorrhoea.

Other Oxidizing Antiseptics

Sodium Perborate (Sodii Perboras)

This is the sodium salt of perboric acid. It contains 9% of oxygen and is used as an antiseptic for wounds and ulcers and as a dusting powder.

Perogen Bath Salts or Oxygen Bath Salts is a compound containing 10% of sodium perborate.

IODOFORM

Iodoform is a yellow crystalline powder which has a very characteristic odor and a sweet taste. It is a compound of methane (marsh gas) with iodine and contains about 97% of iodine.

ACTION

Local action: Applied to the skin, to wounds or mucous membranes, iodoform acts as a mild antiseptic and disinfectant. It absorbs the fluids from the wound and in this way it prevents the growth of bacteria. Iodoform is very soothing to the skin or mucous membranes.

Poisonous Effects

Iodoform is often absorbed into the blood from wounds or sinuses, especially when the surface of the wound is very extensive. This is more apt to occur in adults or susceptible

individuals. It produces the following characteristic poisonous symptoms:

1. In mild cases there may be only a rise of temperature; 104° to 105° F. Headache, dizziness, very rapid pulse and loss of appetite, also occasionally occur.

In severe cases the following symptoms may also occur:

2. The patient feels depressed, downhearted, even melancholy.

3. Hallucinations (ideas of being persecuted and attempts at suicide).

4. Delirium, even mania.

5. Collapse, which may cause death.

The symptoms may last for several hours or days. Occasionally there is no excitement, the patient goes into stupor and dies of collapse.

Preparations

Iodoform (**Iodoformum**)	0.03–0.2 gm.	grs. $\frac{1}{2}$–iii

This is used principally externally in wounds and sinuses in the form of Iodoform gauze.

Iodoform gauze is made by soaking sterile gauze in a solution containing 5–10% of Iodoform, 20–15% of glycerine and adding alcohol up to 100 c.c.

Iodoform Ointment
(Unguentum Iodoformi)

This contains 10% of iodoform.

New and Non-official Derivatives

Iodol (**Iodo um**)	0.25 gm.	grs. iv

This is an artificial chemical substance formed by the action of iodine on mineral oils. It contains 85% of iodine, but its odor is not as unpleasant as that of iodoform.

Iodoformogen
(Iodoformalbumen)

This is an odorless compound of iodoform and albumin. It is used principally as a dusting powder.

Aristol
(Thymolis Iodidum)

This is a yellowish brown powder which is used like iodoform but it has a more pleasant odor.

Europhen: This is an artificial chemical substance which is used as a dusting powder. It is occasionally given internally in doses of 0.2–0.3 gm. (grs. iii–v).

Vioform: This is an artificial chemical substance, containing iodine, which acts like iodoform. It is more efficient than iodoform and does not cause poisonous symptoms.

Antiseptol
Antiseptin
Sozoiodol
Sozal
Sulphaminol
Thiophene

These are other unofficial derivatives of iodoform.

BISMUTH PREPARATIONS

A number of preparations of bismuth have been made, consisting of bismuth combined with a carbolic acid derivative. The bismuth itself is only slightly disinfectant. This action is due to its insolubility, so that it absorbs the fluid from the wounds and the bacilli are unable to grow. Most of the antiseptic action, however, is due to the phenol derivative.

Preparations

Bismuth Subgallate (Dermatol)
(Bismuthi Subgallas)

This is used as an antiseptic dusting powder on wounds. Gauze soaked in bismuth is now frequently used instead of

iodoform gauze. Bismuth paste is frequently injected into deep wounds (sinuses) to make them heal more readily.

Bismuth Subcarbolate
(Bismuthi Subcarbolas)

New and Non-official Preparations

Airol
(Bismuth Iodosubgallate)

This combines the action of iodoform and bismuth and is odorless.

Thioform
(Bismuthi Dithio Salicylate)
Xeroform
(Bismuthi Tribromphenolas)
Bismuth Phenolate
Bismuth Cresolate
Bismuth Sulphocarbolate
Dermol
(Bismuth Chrysophenate)
Eudoxin

These are used as antiseptic and astringent dusting powders for wounds and various skin diseases. They are also given as intestinal antiseptics in doses of 1.0–4.0 c.c. (grs. xv–℥i).

PICRIC ACID

Picric acid is a yellow crystalline powder.

When applied locally it checks the growth of bacteria (antiseptic) and contracts the skin and mucous membranes. It is used in the form of wet dressings on burns and other wounds and occasionally as douches. It is often applied in the form of an ointment.

In large doses it is absorbed from the skin and causes the following poisonous symptoms: a yellow color of the skin and mucous membranes; the urine is also intensely yellow in color. It occasionally causes convulsions and collapse.

BALSAM OF PERU (BALSAMUM PERUVIANUM)

Balsam of Peru is a dark brown syrupy fluid, which does not dissolve in water. It is a balsam which oozes from the trunk of the **Toluifera pereirae**, a tree growing in Central America and India.

Balsam of Peru is used in the form of gauze saturated with the balsam. This is applied to wounds and ulcers as an antiseptic, and to promote healing by increasing the growth of granulation tissue.

When given internally, it acts as an antiseptic in the stomach and intestines, and aids in the expulsion of gas. After absorption it increases the cough and expectoration. Its effect is due to the benzoic acid which it contains.

Preparations

Balsam of Peru (**Balsamum Peruvianum**)	0.3–1.0 c.c.	m. v–xv

ANTISEPTICS USED FOR MUCOUS MEMBRANE LINED CAVITIES

BORIC ACID AND BORAX

Boric acid or boracic acid is a weak acid formed by the combination of the element boron with hydrogen.

ACTION

Local action: Applied to the skin or mucous membranes, boric acid checks the growth of bacteria, but does not destroy them (antiseptic). It is also soothing to the skin.

Boric acid is rarely used internally, but when it is given, it increases the flow of urine.

Poisonous Effects

The irrigation of abscess cavities, the pleural cavity and other cavities of the body with boric acid, has occasionally caused the following symptoms:

1. Abdominal pain.
2. Nausea, vomiting and diarrhoea.
3. Headache and dimness of vision.
4. Collapse; rapid, thready pulse, slow shallow breathing and subnormal temperature.

Death may result from the collapse.

Continued use of boric acid even in the form of wet dressings, causes scaly skin eruptions such as eczema, and baldness.

Uses

Boric acid is used as an antiseptic for mucous membranes such as the conjunctiva. It is especially valuable as a mouth wash and gargle because of its mild action, and it is the principal ingredient of most mouth washes. It is also used to irrigate wounds and abscess cavities.

Preparations

Boric Acid (Boracic Acid) (Acidum Boricum)	0.3–1.0 gm.	grs. v–xv

For external use 2–5% solutions are employed.

Sodium Borate (Borax) (Sodii Boras)	0.3–1.0 gm.	grs. v–xv

Boroglycerine
(Glyceritum Boroglycerini)

This is a compound formed by heating boric acid in glycerine. It contains 31% of boric acid.

Liquor Antisepticus

This is a compound containing 2% of boric acid together with benzoic acid, thymol, eucalyptol, oil of peppermint and oil of thyme. It is marketed under the name of **Glyco Thymoline.**

Dobell's Solution

This contains 1½% of sodium borate, carbolic acid, sodium bicarbonate, glycerine and water. It is used as an alkaline gargle and as an antiseptic nasal douche.

Boric Acid Ointment
(Unguentum Acidi Borici)

This contains 10% of boric acid.

Listerine (Not official)

This is a compound containing 2½% of boric acid, together with benzoic acid, thymol, eucalyptol, oil of wintergreen, oil of peppermint, tincture of baptista, alcohol and water.

For the nose and larynx the following preparations are principally used:

Boric Acid (in 2–5% solutions)
Dobell's Solution
Eucalyptol
Benzoin

INTESTINAL ANTISEPTICS

NAPHTHALENE

Naphthalene is a substance obtained from coal tar.

ACTION

Applied to the skin or mucous membranes it checks the growth of bacteria. **When given internally,** it checks the growth of bacteria in the intestines thereby relieving the formation of gas. A little of the naphthalene is absorbed into the blood, and this is eliminated by the lungs. Here it increases the secretion of the mucous membrane and also acts as an antiseptic. Most of it is excreted by the foeces.

Large doses cause symptoms like that of carbolic acid poisoning.

Naphthalene is used principally as an intestinal antiseptic for tape worms; to increase coughing, and as an antiseptic for abscesses in the lungs.

Preparations

Naphthalene (Naphthalenum)		0.06–0.3 gm.	grs. i–v
Betanaphthol (Naphthol)		0.2–0.6 gm.	grs. iii–x
Betanaphthol Benzoate (Naphtholis Benzoas)	(Not official)	0.2–0.5 gm.	grs. iii–viii

This forms benzoic acid and naphthol in the intestines.

Betol (Naphtholis Salicylas)	(Not official)	0.3–0.5 gm.	grs. v–viii

This forms salol and naphthol in the intestines.

All these preparations should be given in keratin coated pills so that they will be dissolved only by the alkaline juices in the intestines.

THYMOL

Thymol, a substance which is principally used as a remedy for hookworms, is also used as an intestinal antiseptic.

EUCALYPTOL

Eucalyptol is a substance obtained from the oil of eucalyptus and other volatile oils. The oil of eucalyptus is the active volatile oil of the **Eucalyptus globulus,** or **blue gum tree,** which grows in southern countries and has the peculiar quality of absorbing moisture from the soil. It is therefore used to drain swamps, and it helps to purify a malarial district in this way; since mosquitoes develop in swampy regions.

ACTION

Eucalyptol produces the following effects:

1. **Locally;** it acts as an antiseptic and reddens the skin and mucous membranes.
2. **Internally;** it checks the growth of bacteria in the intestines and increases the secretions.
3. After absorption it increases all the secretions, such as the perspiration and bronchial mucus. It also makes the pulse stronger and faster.
4. It is used in the treatment of malaria, as an intestinal antiseptic, and is inhaled in lung abscesses and fetid bronchitis.

Preparations

Eucalyptol	0.3–1.0 c.c.	m. v–xv
Oil of Eucalyptus	0.3–1.0 c.c.	m. v–xv
Apinol	0.3–1.0 c.c.	m. v–xv

This is a substance obtained by the destructive distillation of pine wood. It is used principally as an intestinal antiseptic and to loosen the mucus in the bronchi.

ANTISEPTICS ACTING AFTER ABSORPTION

The following group of drugs act as antiseptics on the various organs through which they are excreted.

ANTISEPTICS ACTING ON THE LUNGS

CREOSOTE

Creosote is a substance made by distilling wood tar. Its action is due to the guiacol which it contains.

ACTION

The action of creosote is similar to that of carbolic acid; it is not as strong an antiseptic as carbolic acid, but it is more poisonous. It produces the following effects:

1. Locally, it relieves pain and acts as an antiseptic.
2. When given internally, it acts as an intestinal antiseptic.
3. It is absorbed from the intestines and it then lowers temperature, increases the perspiration and all the secretions, especially the bronchial secretions.
4. It is eliminated by the lungs and urine. It acts as an antiseptic in both of these organs.

Creosote is used principally as an antiseptic in pulmonary tuberculosis or lung abscesses, to destroy the bacteria in the lungs. It is often given by inhalation.

Preparations

Creosote (**Creosotum**)	0.06–0.3 c.c.	m. i–v
Creosote Water (**Aqua Creosoti**)	2.0–8.0 c.c.	ʒ½–ii

This contains 1% of creosote.

Creosote Carbonate (not official) (**Creosotal**)	0.3–2.0 gms.	grs. v–xxx

GUIACOL

Guiacol is a colorless volatile liquid made by the distillation of beechwood tar creosote.

The action of guiacol is like that of creosote, with the following differences:

1. It may be absorbed from the skin and then reduce temperature.
2. Large doses often turn the urine a dark brown color and cause diarrhoea.

It is used for the same conditions as creosote.

Preparations

Guiacol	0.5 c.c.	m. viii
Guiacol Carbonate (Duotal) (Guiacol Carbonas)	0.3–1.3 gm.	grs. v–xx

New and Non-Official Preparations

Guiacol Salol (Guiacolis Salicylas)	1.0 gm.	grs. xv
Guiamar	0.3–1.3 gms.	grs. v–xx
Guiajasanol	1.0–3.0 gms.	grs. xv–xlv
Monotal (Guiacolis Methylglycolas)	2.0–4.0 gms.	$3\frac{1}{2}$–i
Guiacol Cinnamate (Styracol)	1.0 gm.	grs. xv

This combines the antiseptic properties of guiacol and cinnamic acid.

GENITO-URINARY ANTISEPTICS

The drugs in the following group are used principally as urinary antiseptics. They are eliminated by the urine, destroying the bacteria in the kidneys, ureters and bladder, in their passage through these organs.

BENZOIC ACID AND ITS SALTS

Benzoic acid or flower of benzoin is an organic acid obtained from benzoin; the hardened sap of the **Styrax benzoini**, a Peruvian tree. Benzoic acid is one of the oldest antiseptics known. It was contained, together with cinnamic acid, a closely related substance, in the balsams which the Egyptians used to embalm their dead. The excellent preservation of their mummies even at the present time attests to the efficiency of these substances.

ACTION

Local action: Applied to the skin or mucous membranes benzoic acid acts as an antiseptic. It also increases the secretion of all mucous membranes.

Internal action: When taken internally, benzoic acid or its compounds check the growth of bacteria in the intestines. It is absorbed from the stomach and intestines, and it then makes the pulse faster, and increases the secretions; especially the sweat and bronchial secretions.

It is eliminated by the urine; which it slightly increases. It acts as an antiseptic along the urinary tract. It is excreted as hippuric acid, which makes the urine more acid in reaction.

Preparations

Benzoic Acid (Acidum Benzoicum)	0.3–1.0 gm.	grs. v–xv
Sodium Benzoate (Sodii Benzoas)	0.3–2.0 gms.	grs. v–xxx

This is used principally as a urinary antiseptic. It is also frequently used as a preservative for canned foods.

Ammonium Benzoate (Ammonii Benzoas)	0.3–2.0 gms.	grs. v–xxx
Lithium Benzoate (Lithii Benzoas)	0.3–2.0 gms.	grs. v–xxx

Benzoin

This is the thickened sap obtained from the **Styrax benzoini**, a Peruvian tree. Its compounds are used principally to increase the secretions in the lungs, and in inflammations of the nose and bronchi.

Tincture of Benzoin (Tinctura Benzoini)	2.0–4.0 c.c.	$\mathfrak{Z}\frac{1}{2}$–i
Compound Tincture of Benzoin (Tinctura Benzoini Composita)	2.0–8.0 c.c.	$\mathfrak{Z}\frac{1}{2}$–ii

This contains benzoin, styrax, aloes and balsam of Tolu. It was formerly known as **Balsamum traumaticum.** It is contained in a number of old remedies, such as **Friar's balsam, Turlington's balsam, Jesuit's drops,** etc. It is frequently given by inhalation for inflammations of the larynx and bronchi. Benzoin is also contained in the balsam of Peru and balsam of Tolu.

Cinnamic acid is a substance closely related chemically to benzoic acid and produces the same effects.

Styrax or **storax** is the sap obtained from the inner bark of the **Liquidamber orientalis,** an Asiatic tree. It contains cinnamic acid.

DRUGS CONTAINING VOLATILE OILS ACTING AS GENITO-URINARY ANTISEPTICS

The following drugs act as antiseptics on the mucous membranes of the genito-urinary tract, by virtue of the volatile oils which they contain. They all have practically the same action.

ACTION

When applied locally, they redden the skin or mucous membranes.

When taken internally, they check the formation, and aid in the expulsion of gas from the intestines, and act as cathartics. They are absorbed from the stomach and intestines, but produce no effects, except a slight reduction of temperature.

They are eliminated by the urine and expired air, acting as antiseptics on the mucous membranes of the organs through which they are excreted. They slightly increase the flow of urine.

The drugs of this group are used principally as antiseptics for gonorrhoea, cystitis, etc.

Large doses often cause nausea and vomiting and various rashes, such as urticaria.

Preparations

COPAIBA: An oleoresin obtained from the sap of the **Copaiba Langsdorfii,** a tree growing in Brazil and other South American countries.

Copaiba	0.6–2.0 c.c.	m. x–xxx
Oil of Copaiba (**Oleum Copaibae**)	0.6–1.0 c.c.	m. x–xxx

CUBEBS: A powder made from the unripe fruit of the **Piper Cupeba,** an East Indian Plant.

Fluidextract of Cubebs (Fluidextractum Cubebae)	0.6–2.0 c.c.	m. x–xxx
Oleoresin of Cubebs (Oleoresina Cubebae)	0.6–1.0 c.c.	m. x–xv
Oil of Cubebs (Oleum Cubebae)	0.6–1.0 c.c.	m. x–xv

SANDAL WOOD OIL: A volatile oil distilled from the wood of the **Santalum album,** an American tree.

Oil of Sandal Wood (Oleum Santali)	0.6–1.0 c.c.	m. x–xv

OIL OF ERYGERON: This is a volatile oil obtained by distilling **Erygeron canadense,** or Canada fleabane, an American herb. It is used as a genito-urinary antiseptic, to check bleeding and to increase menstruation.

Oil of Erygeron (Oleum Erygerontis)	0.3–2.0	m. v–xxx

BUCHU: This is a substance obtained from the leaves of the **Barosma betulina** and **Barosma crenulata,** two South American plants. Its active principle is a stearoptene, **Diosphenol,** which is excreted by the urine and acts as an antiseptic along the genito-urinary tract. It is used in the treatment of gonorrhoea.

Fluidextract of Buchu (Fluidextractum Buchu)	2.0–4.0 c.c.	ʒss–i

MATICO: This is the dried tops of **Piper angustifoliorum,** a South American plant. It is used as a genito-urinary antiseptic.

Fluidextract of Matico (Fluidextractum Matico)	1.0–3.0 c.c.	m. xv–xlv

HEXAMETHYLENAMINE (UROTROPINE)

Hexamethylenamine or Urotropine is an artificial chemical substance which is used principally as a urinary antiseptic.

ACTION

Hexamethylenamine liberates formaldehyde in the urine. This disinfects the urine and the mucous membranes of the

genitourinary tract with which it comes in contact. It only acts when the urine is acid.

It has also been used in various septic conditions because of the formaldehyde gas which it liberates in the blood and secretions. It has frequently been injected into the spinal canal for meningitis.

Large doses occasionally cause burning pain in the stomach, pain on urination, and the urine occasionally contains blood.

Preparations

Hexamethylenamine (Urotropine)	0.2–0.6 gm.	grs. iii–x

This preparation is also on the market under various names, such as **Formin, Aminoform,** etc. Other unofficial compounds of Hexamethylenamine are:

Hexalet (Hexamethylenamine Salicylsulphonic Acid)	0.3–1.0 gm.	grs. v–xv
Helmitol (Hexamethylenaminae Methylencitras)	0.3–1.0 gm.	grs. v–xv
Saliformin (Hexamethylenaminae Salicylas)	0.3–2.0 gms.	grs. v–xxx
Aminoform	0.3 gm.	grs. v
Formin	0.3 gm.	grs. v
Amphotropin	0.3 gm.	grs. v
Hexamethylenamine Methylene Citrate	0.6–1.0 gms.	grs. x–xv

METHYLENE BLUE (METHYLTHIONINAE HYDROCHLORIDUM)

Methylene blue is a chemical substance which forms a deep blue solution in water. It is used principally as a urinary antiseptic in gonorrhoea, and as a specific for malaria. It stains the urine a blue or dark green color. It is given in capsules, in doses of 0.1–0.5 gm. (grs. ii–viii).

CHAPTER XXXIII

DRUGS ACTING CHIEFLY ON THE SKIN

The drugs which are used for their effects on the skin may be divided into the following groups: **Counterirritants and drugs which soothe or protect the skin.** Counterirritants are used to irritate the skin and to produce other remote effects.

Demulcents, emollients and protectives are substances which soothe and protect the skin.

COUNTERIRRITANTS

Counterirritants or skin irritants are drugs which are used principally for their effects on the skin. They produce two kinds of effects: local and remote.

Local Effects

The local effects are those produced at the site of application, and depend upon the length of time the drug is applied, or upon the strength of the preparation used. Thus, a weak preparation applied for a short time, produces only redness; if the same preparation is allowed to remain on the skin for a longer time, or if a stronger preparation is used, a blister will form. A still stronger action consists in the destruction of the skin, with death of the tissue (caustic or escharotic action).

Remote Effects

The remote effects produced by counterirritants are of two kinds: **circulatory** and **reflex.**

The circulatory effects are due to the reddening of the skin. This brings **more blood to the surface of the skin** from the underlying or deeper tissues and organs, which then become anaemic. Thus, by removing some of their blood, counterirritants relieve inflammation or congestion of the

deeper organs. For example, the application of a mustard plaster to the chest will often relieve bronchitis (inflammation of the bronchi) by withdrawing the blood from the inflamed bronchi to the surface of the skin.

The **reflex effects** are due to the action on the nerve areas in the skin which are associated with those of the deeper organs. By affecting these nerve endings, pain in some of the deeper organs may be relieved. For example, the application of a flaxseed poultice to the ensiform cartilage often relieves various pains in the stomach. The other reflex effects of counterirritants are a slight increase in the blood pressure and momentary deeper breathing; but these effects are very slight.

The counterirritants are best classified in the following way according to the effects they produce in the usual strengths which are commonly used, though the same effects can be obtained from all of them.

1. **Rubefacients:** Drugs that produce redness of the skin.
2. **Vesicants:** Drugs that produce blisters on the skin.
3. **Caustics:** Escharotics: Drugs that destroy the skin.
4. Pustulants are drugs now seldom used, which form pustules.

The counterirritants may be used either for their local effect on the skin or for their effects on the deeper organs.

RUBEFACIENTS

The rubefacients are used principally to redden the skin, to relieve congestion of the underlying tissues and to relieve pain in remote organs. Heat, cold applications and cupping may produce the same effects.

SINAPIS—MUSTARD

There are two kinds of mustard:

Sinapis Alba (White Mustard)
Sinapis Nigra (Black Mustard)

Mustard is the powdered dried ripe seeds of **Brassica alba** and **Brassica nigra,** which are European plants growing in temperate climates, throughout the world

Black mustard is usually much stronger than the white.

The active principles of **black mustard** are **sinigrin,** a glucoside, and **myrosin,** a ferment.

When water is added to black mustard, it is decomposed; the myrosin acts on the sinigrin and changes it to dextrose, a sugar, and the volatile oil of mustard, which is the active ingredient.

The active principles of **white mustard** are **sinalbin,** a glucoside, and a ferment, **myrosin.**

When water is added to white mustard it is also decomposed. The myrosin acts on the sinalbin, changing it to dextrose, a sugar, and an alkaloid, sinapine sulphate.

ACTION

Local Action: Applied to the skin, mustard makes it red and warm (rubefacient action), because it widens the capillaries. It thus draws blood to the surface from the deeper tissues or organs. If the application is left on for a long time, or if the preparation is very strong, blisters are formed (vesicant action). If the application is allowed to remain on the skin for a still longer time, pustules may form, and the skin may even be destroyed at the spot of application (caustic action).

Internal Action

In the stomach, small quantities of mustard increase the appetite and the secretion of gastric juice, and therefore aid the digestion of food. For this purpose, mustard is never prescribed, but it is commonly used as a condiment with food.

In doses in which mustard is usually prescribed, it produces nausea and vomiting. It is used extensively for this purpose, especially in cases of poisoning from various drugs.

Since it causes vomiting in moderate doses, mustard is not absorbed, and produces no other effects, than those due to the vomiting.

Methods of Administration

For Local Applications:

(1) **Plaster:** This is dipped in lukewarm water and applied.

(2) **Mustard paste:** This is usually made up with flour, us-

ing one part of mustard to four parts of flour. It must be made with tepid water, as hot water, alcohol and vinegar prevent the formation of the active oil which is formed and no effect then results from the application.

The paste should not be applied directly to the skin, but by means of a piece of thin gauze or lint.

(3) **Powdered mustard** may be sprinkled over an ordinary poultice, and the poultice then applied to the skin.

Local applications of mustard should not be left on longer than fifteen to thirty minutes.

(4) **Mustard Baths** are common methods of administering mustard for a local effect, and to relieve congestion of internal organs. About two to four teaspoonfuls of the dried powder are added to each gallon of water.

Preparations

White Mustard powder
(Sinapis Alba)

Black Mustard powder
(Sinapis Nigra)

Mustard Paper, or mustard plaster
(Charta Sinapis)

This consists of black mustard powder, to which India rubber is added to make it more adhesive, and the mixture is then applied to sheets of paper and dried.

TURPENTINE (TEREBINTHINA)

There are two kinds of turpentine: **turpentine** or **white turpentine,** and **Canada turpentine** or **Canada balsam.**

Turpentine, or white turpentine, terebinthina, is a thick resinous substance, or solid oleoresin obtained from the sap of the **Pinus palustris,** and other species of pine trees.

Canada turpentine, **terebinthina canadensis**, or Canada balsam, or balsam of fir, is a liquid oleoresin obtained from the **Abies balsamea,** the American silver fir, or balm of gilead tree, which grows in the northern parts of the United States. This form of turpentine is seldom used. The turpentines contain a volatile oil, oil of turpentine, or spirit of turpentine, which causes their effects.

ACTION

Local action: Turpentine or the spirit of turpentine, reddens the skin. If it is kept on the skin for any length of time, it causes blisters.

Internal Action

When taken internally, the oil of turpentine produces the following effects.

In the stomach: It checks the formation, and hastens the expulsion of gas. Part of it is absorbed into the blood from the stomach.

In the intestines: It acts as an antiseptic, checking the growth of bacteria. It expels gas and increases peristalsis. It is said to expel worms.

On the kidneys: Turpentine and the oil of turpentine increase the flow of urine. This effect is produced by the turpentine after it is absorbed into the blood.

Turpentine is said to make the pulse somewhat stronger and faster.

Excretion

Turpentine is eliminated from the body by the lungs, where it increases the cough and expectoration, and acts as an antiseptic. It is also excreted by the kidneys and gives the urine a violet color.

Poisonous Effects

Overdoses of turpentine cause:

1. Unconsciousness.
2. Scanty, often bloody urine.
3. Rapid, feeble pulse.
4. Occasionally vomiting, and diarrhoea, with painful stools.

Uses

Turpentine is applied to the skin to relieve pain and to withdraw blood from the deeper tissues; occasionally to form a blister.

To increase the flow of urine.

To expel gas from the intestines.

To increase the cough and expectoration, and to check the growth of bacteria in the lungs.

Administration

For its effects on the skin, turpentine liniments are used, or the drug is applied in the form of a "stupe."

Turpentine Stupe

A turpentine stupe is applied by dipping a piece of flannel in hot water, to which a few drops of hot turpentine oil have been added. The flannel is wrung out, and applied over the skin, which should be covered with vaseline to prevent the formation of blisters. Another method of applying turpentine consists of painting the skin of the abdomen with a mixture of one part of turpentine to two parts of an oil, such as olive or cottonseed oil. A piece of flannel which has been wrung out of hot water is then applied over the painted area of skin.

Internally, turpentine is best given in capsules or in an emulsion. As an expectorant, it is frequently given by inhalations.

Turpentine is also often added to enemas to help the expulsion of gas.

Preparations

Oil of Turpentine (Oleum Terebinthinae) 0.3–1.0 c.c. m. v–xv

This is obtained by distilling turpentine.

Purified Oil of Turpentine (Oleum Terebinthinae Rectificatum) 0.3–1.0 c.c. m. v–xv

Emulsion of Turpentine Oil (Emulsum Olei Terebinthinæ) 4.0 c.c. ʒi

Turpentine Liniment (Linimentum Terebinthinae)

TEREBENE: This is a substance formed from the oil of turpentine. It acts like turpentine but it is preferable for internal use as an expectorant. It is given in doses of 0.3–2.0 c.c. (m. v–xxx.)

CAPSICUM

Cayenne pepper is used in the form of a plaster. For other actions see page 138.

AMMONIA LINIMENT

This contains 35% of ammonia water in cottonseed oil and alcohol. It is frequently used as a rubefacient.

ARNICA

Arnica is obtained from the flowers of the **Arnica montana**, or leopard's bane, a plant growing in northern Europe, Asia and the northwestern part of the United States. Its active principle is **arnicin**, an alkaloid.

It is commonly used in the form of a tincture to absorb haematomata and as a counterirritant in bruises.

Other Rubefacients

Chloroform Liniment
Camphor Liniment
Sabine
Juniper

VESICANTS

Vesicants or Epispastics are drugs used to produce blisters. In this way they withdraw fluid from the deeper tissues into the blister. They are used to produce this effect in joint affections, in various inflammations of the internal organs and for neuralgic pains. They may be absorbed, and may then weaken the patient. They should not therefore be used on very old patients or on infants.

CANTHARIS (CANTHARIDES)

Cantharides or Spanish fly is a dried beetle found in various temperate climates, especially in Spain and Italy. Its active principle is a neutral substance, **cantharidin.**

ACTION

Applied to the skin: it causes redness and swelling with the formation of a blister. **Internally,** in small doses it increases the flow of urine. It is said to increase sexual desire.

Poisonous Effects

Absorption of cantharides from the skin, or when taken internally in large doses, produces the following symptoms; which are due to the injury of the kidneys and alimentary tract.

1. Profuse vomiting and diarrhoea.
2. Painful, scanty urination, with scanty urine, which often contains blood.
3. Delirium, convulsions and collapse.

If it is taken in solution it causes blisters in the mouth and oesophagus, which often prevent swallowing.

The symptoms are best relieved by washing out the stomach, the administration of opium for the pain, and giving demulcent drinks.

Preparations

Cerate of Cantharides (Ceratum Cantharidis)	
Cantharides Collodion (Collodium Cantharidatum)	
Tincture of Cantharides (Tinctura Cantharidis)	0.12–0.3 c.c. m. ii–v

Cantharides is frequently applied in the form of a plaster: a small piece of the plaster, the size of a dime is applied over the affected area.

Before applying cantharides, the skin should be shaved, cleansed with soap and water, alcohol and ether. The plaster

is then applied and left on for about 4 to 8 hours, depending upon the effect desired.

Cantharis Vittata: This is the dried potato fly which contains cantharidin. It is occasionally used as a substitute for cantharides.

Strong Ammonia Water
(Aqua Ammoniae Fortior)

This is frequently used to produce blisters.

PUSTULANTS

Pustulants are drugs which produce very violent action on the skin with the formation of a group of pustules. They are not used very frequently. The remedies which were formerly used for this purpose were **Croton Oil** and **Antimony.**

CAUSTICS OR ESCHAROTICS

Caustics or escharotics are drugs which are applied locally to destroy tissues. The destroyed tissue is called the **slough** or **eschar.** The action may be mild or severe. The drugs that have a mild action are used principally in the treatment of various skin diseases and for the removal of scars.

The substances that are more destructive to the tissues are used principally to destroy infected tissue, such as the bite of an animal, and to remove warts.

Substances of Mild Action

CHRYSAROBIN

Chrysarobin is a substance obtained from cavities in the **Andira araroba,** a tree growing in India and Brazil. Its active principle is **chrysophanic acid.**

When applied to the skin, it causes redness, pain and even swelling. Large doses, when absorbed from the skin or when taken internally, cause nausea, vomiting, diarrhoea and scanty, bloody urine.

It is used principally in 4% ointments for the treatment of various skin diseases.

Araroba or **Goa Powder,** is the crude powder from which chrysarobin is made.

SCARLET RED (not official)

This is a chemical dye which is said to increase the formation of granulation tissue (newly forming scar tissue). It is used for this purpose in 4–8% ointments in the treatment of wounds and ulcers.

THIOSINAMINE (not official)

Thiosinamine is a crystalline, colorless substance made from the oil of mustard, by the action of an alcoholic solution of ammonia. Chemically, it is called allyl sulphocarbamide, allyl thiourea, or rhodaline.

It causes absorption of scar tissue in various parts of the body.

It is therefore used to remove scar tissue in the eye, the skin, the stomach, the urethra, etc.

Administration

Thiosinamine is used locally in the form of plasters or ointments containing 10% of thiosinamine.

It is usually given hypodermically however, in 10% or 15% solutions, and occasionally it is given by mouth in capsules.

Preparations

Thiosinamine (Thiosinamina)	0.03–0.1 gm	gr. ½–1½

FIBROLYSIN (not official)

Fibrolysin is a salt made from thiosinamine. Chemically it is thiosinamine sodium salicylate.

Its action is the same as that of thiosinamine but it is more quickly absorbed.

It is given hypodermically, intramuscularly, or intravenously for the absorption of scar tissue in various parts of the body.

Fibrolysin usually comes in small glass vials, each containing 2.3 c.c. of fibrolysin, which is equivalent to 0.2 gm. (gr. iii) of thiosinamine.

OIL OF CAJAPUT

This is the volatile oil obtained by distilling the leaves of the **Melaleuca leucadendron,** a tree which grows in the Molucca Islands.

Oil of Cajuput (**Oleum Cajuputi**)	0.3–1.0 c.c.	m. v–xv

The oil of cajuput has been used for the treatment of parasitic skin diseases, and round worms.

Substances of Severe Action

Alkalies

Potassium Hydroxide
Sodium Hydroxide

Acids

Nitric Acid
Glacial Acetic Acid
Trichloracetic Acid
Chromic Acid

Chromic acid occurs in the form of dark purplish crystals which take up moisture from the atmosphere (hygroscopic effect).

Metals

Zinc Chloride
Corrosive Sublimate
Solution of Mercurous Nitrate
Silver Nitrate
Copper Sulphate
Alum
Bromine

DRUGS WHICH SOOTHE OR PROTECT THE TISSUES

The drugs in this group are divided into three classes:

1. **Demulcents:** Drugs which soothe the skin.

2. **Emollients:** Drugs which soften the tissues.
3. **Protectives:** Drugs which protect the skin.

DEMULCENTS

Demulcents are bland substances which are used to soothe inflamed tissues. They are also used to suspend substances which cannot otherwise be dissolved, in mixtures.

ACTION

The demulcents are all sticky substances which swell up into jelly like masses when they are dissolved in water. They prevent the tissues from coming in contact with injurious fluid or gaseous particles, and in this way they relieve the pain of inflammations and protect the tissues from injurious substances.

Preparations

ACACIA or GUM ARABIC: This is the gummy sap obtained from the **Acacia senegal,** an African tree. It contains **calcium** combined with **arabic acid.** It is used in making emulsions of various drugs and pills.

Mucilage of Acacia 16.0. c.c. ℥iv
(Mucilago Acaciae)

This contains one part of acacia to two parts of water.

Syrup of Acacia
(Syrupus Acaciae)

TRAGACANTH: This is a gummy sap obtained from the **Astragalus gummifer,** an Oriental tree. It is principally used to suspend heavy powders in water and in the making of pills.

Mucilage of Tragacanth **16.0 c.c.** ℥**iv**
(Mucilago Tragacanthae)

ULMUS or ELM: This is the inner bark of the **Ulmus fulva** or slippery elm tree of the United States. When mixed with

water it forms a mucilage-like substance which is very soothing to the tissues. It is often used in the form of a poultice.

Mucilage of Elm
(Mucilago Ulmi)

ALTHAEA: This is obtained from the root of **Althaea officinalis** or marshmallow.

LINUM (flaxseed or linseed). This is the dried ripe seed of **Linum usitatissimum** or the flax plant.

Flaxseed meal is the ground dried seeds and is used principally as a poultice. The seeds themselves are often given in the form of an infusion (flaxseed tea) to relieve bronchitis, painful urination and painful defecation.

SASSAFRAS MEDULLA: This is the pith of **Sassafras varifoliorum.** The mucilage of sassafras is principally used to soothe inflammations of the eye, and is occasionally given internally.

GLYCYRRHIZA (LICORICE ROOT): This is the root and underground stems of the **Glycyrrhiza glabra,** an English plant. It is used principally to soothe mucous membranes. It has a very pleasant taste because of its active glucoside, **glycyrrhizin,** and it is used for this reason to flavor medicines.

Extract of Licorice Root (**Extractum Glycyrrhizae**)	1.0 gm.	grs. xv
Fluidextract of Licorice Root (**Fluidextractum Glycyrrhizae**)	2.0 c.c.	m. xxx

AMYLUM (starch): This is ordinary starch which is used in the form of a dusting powder or is boiled in water and then applied as a demulcent.

Glycerite of Starch (Plasmine)
(Glyceritum Amyli)

AMYGDALA DULCIS (Sweet Almonds). This is the seed of **Prunus amygdala dulcis** or the almond tree. It contains a

fixed oil and a ferment, **emulsin.** When the almonds are rubbed together with water, a bland emulsion is formed which is very soothing to the tissues.

Emulsion of Sweet Almonds 16.0 c.c. ʒiv
(Emulsum Amygdalae)

Syrup of Sweet Almonds
(Syrupus Amygdalae)

This is a mixture of sweet and bitter almonds and contains a little prussic acid.

CHONDRUS (Irish Moss or Carragheen): This is obtained from **Chondrus crispus,** a seaweed found on the coast of Ireland and Massachusetts. It forms a jelly-like mass when dissolved in water because of a starchy substance, **carrageenin,** which it contains. Various preparations of chondrus such as **lubrichondrin,** are used as lubricants for the passage of catheters or other instruments.

KAOLINUM (Kaolin): This is a powder which consists of silicates, various salts of silicon, an element. This powder has the property of withdrawing fluid from tissues. It is used in the nose in powder to remove purulent secretions.

It is used in the intestinal tract to absorb secretions and bacteria in colitis and in food poisoning and to protect the intestines when chronic inflammation or ulcers are present. It is also given to check the action of digestive ferments.

Cataplasma Kaolini: This is a clay-like poultice consisting of boric acid, methyl salicylate, glycerine, thymol, oil of peppermint, and kaolin. It withdraws fluid from the tissues and is very soothing. It is on the market under various names; such as **Antiphlogistine, Fuller's Earth,** etc.

TALCUM: This is magnesium silicate and is used as a bland soothing dusting powder.

LYCOPODIUM: This consists of the spores of **Lycopodium clavatum** or club moss. It is used principally as a soothing dusting powder and in the making of pills.

EMOLLIENTS

Emollients are bland fatty substances used to soften the skin and as a medium for applying other drugs to the skin.

Preparations

ADEPS (Lard): This is the prepared internal fat of the abdomen of the pig. It is purified by washing, melting and straining.

Benzoinated Lard
(Adeps Benzoinatus)

Ointment
(Unguentum)

This is a mixture of lard and yellow wax and forms the basis of other ointments.

SEVUM PRAEPARATUM (Suet): This is obtained from the abdominal fat of the sheep.

ADEPS LANAE HYDROSUS (Wool Fat or lanolin): This is the purified fat of sheep's wool. It mixes easily with watery solutions and is readily absorbed by the skin.

PETROLATUM (Paraffin): This is made from petroleum after its more volatile constituents are distilled. It is used principally in ointments to soften the skin. Several of the paraffins which do not melt readily are used in surgery for cosmetic purposes. Some of the more fluid paraffins are used as laxatives.

Petrolatum (Vaseline)

White Petrolatum (White Vaseline)
(Petrolatum Album)

Liquid Petrolatum (Albolene, Russian Mineral Oil, etc.)
(Petrolatum Liquidum)

SURGICAL PARAFFIN OR PLASTIC PARAFFIN

(Paraffin for Films)

Paraffin is a wax-like substance made from petroleum. It is solid at ordinary room temperature but melts on heating.

Paraffin is used as an excellent local application for burns, frostbite, chilblains or ulcers of the leg. It acts mechanically, by coating the burn or ulcer with a fine film which excludes the air. At the same time this film acts as a sort of fine splint thus allowing the new tissue to grow over the area.

Method of Application

The paraffin is melted. The wound surface is thoroughly dried preferably by a spray of warm air applied with an electric drier. The melted paraffin is then applied over the surface with a camel's hair brush or atomizer. A very thin layer of cotton is then applied over the paraffin and another layer of paraffin is applied over that. More cotton is placed over this paraffin and the part is then bandaged.

Preparations

Paraffinum
Paraffin

This melts at about 50° C.

New and Non Official Preparations

Stanolind Surgical Wax

This is a specially prepared brand of paraffin.

Parresine

This is a mixture composed of paraffin, Japan wax, gum elemi, asphalt and eucalyptol. It is said to be better than ordinary paraffin.

OLIVE OIL (Olgum Olivae): This is a fixed oil obtained from the olive, the ripe fruit of **Olea Europea**; a European tree.

OLEUM LINI: The fixed oil of linseed or flaxseed.

OLEUM THEOBROMATIS (Cocoa Butter): The fixed oil expressed from the roasted cocoa bean **Theobroma cacao.** It is used principally to make suppositories.

OLEUM GOSSYPI SEMINIS (Cotton Seed Oil): The fixed oil expressed from the seeds of the cotton plant.

CETACUM (Spermaceti): This is a fatty substance obtained from the head of the sperm whale. It is used to give consistency to many ointments such as cold cream.

CERA FLAVA: The yellow wax obtained from the honeycomb of the bee.

CERA ALBA: This is white wax made by bleaching the yellow wax.

Both of these substances are used in making ointments, cerates and plasters.

CERATUM: This is a mixture of 3 parts of wax and 7 parts of lard.

GLYCERINUM (GLYCERINE)

Glycerine is a liquid made by decomposing animal or vegetable fats.

When applied to the skin or to a wounded surface, glycerine smarts and is painful for a few minutes, and then it softens the skin. It has the property of withdrawing fluid from the tissues (hygroscopic).

It is often given internally or it is injected into the rectum. It then produces mild movements of the bowels without any colic.

Glycerite of Starch
(Glyceritum Amyli)

Glycerin of Egg Yolk
(Glyceritum Vitelli)

There are a number of preparations of various drugs made up with glycerine. They are known as glycerites.

PROTECTIVES

Protectives are substances used to protect the tissues, to keep out infectious material, light or air.

COLLODIUM (Collodion): This is a 4% solution of pyroxilin or soluble gun cotton, in alcohol and ether. When collodion is applied to the skin, the alcohol and ether evaporate, leaving a colorless transparent contractile film, which is strongly adherent to the skin and protects it.

Collodion
(Collodium)

Flexible Collodion
(Collodium Flexile)

This contains Canada turpentine and castor oil in addition to the other ingredients, and is more pliable.

Styptic Collodion
(Collodium Stypticum)

This contains 20% of tannic acid and is therefore astringent.

ELASTICA (India Rubber or Caoutchouc): The dried milky juice of a Brazilian tree. It is known as Para rubber. It is used in making adhesive plaster, bougies, etc.

CALCII SULPHAS EXSICCATUS: This is dried gypsum or **plaster of Paris.** When dissolved in water it forms a thick gelatinous mass which becomes hard when exposed to the air. It is used in the form of a gelatinous mass or as bandages filled with the dried powder.

PART XI—MISCELLANEOUS

CHAPTER XXXIV

FLAVORING SUBSTANCES

There are a number of substances which are used principally to flavor prescriptions containing unpleasant tasting drugs. Most of them are obtained from plants or fruits that have a pleasant aroma.

The pleasant odor is due to volatile oils which they contain. As a result these substances may also act as carminatives, checking the formation, and aiding the expulsion of gas in the stomach and intestines. The following are the drugs and preparations commonly used as flavoring substances:

AURANTII DULCIS CORTEX (Sweet Orange Peel)

AURANTII AMARI CORTEX (Bitter Orange Peel)

Tincture of Sweet Orange Peel (Tincture Aurantii Dulcis)	4.0–8.0 c.c.	ʒi–ii
Tincture of Bitter Orange Peel (Tincture Aurantii Amari)	4.0–8.00 c.c.	ʒi–ii

MENTHA PIPERITA (Peppermint Leaves)

Spirits of Peppermint (Spiritus Menthae Piperitae)	2.0–8.0 c.c.	ʒ½–ii
Peppermint Water (Aqua Menthae Piperitae)		

MENTHA VIRIDIS (Spearmint Leaves)

Spirits of Spearmint (Spiritus Menthae Viridis)	4.0–8.0 c.c.	ʒi–ii
Spearmint Water (Aqua Menthae Viridis)		

CINNAMOMI CORTEX (Cinnamon Bark)

Cinnamon Spirits (Spiritus Cinnamomi)	4.0–8.0 c.c.	ʒi–ii
Cinnamon Water (Aqua Cinnamomi)		

WINTERGREEN

Oil of Wintergreen (Oleum Gaultheriae)	0.3–1.0 c.c.	m. v–xv
Spirits of Wintergreen (Spiritus Gaultheriae) 5% of the oil	0.6–2.0 c.c.	m. x–xxx

This contains methyl salicylate and is used for rheumatism.

LAVANDULA (Lavender Flowers)

Spirits of Lavender (Spiritus Lavandulae)	4.0–8.0 c.c.	ʒi–ii
Compound Tincture of Lavender (Tincture Lavandulae Composita) (This contains lavender, rosemary, cinnamon and nutmeg.)	4.0–8.0 c.c.	ʒi–ii

ROSA GALLICAE PETALAE (Red Rose Petals)

Rose Water
(Aqua Rosae)

Unguentum Aqua Rosae
(Cold Cream)

ROSEMARY

This is a drug obtained from the fresh flowering tops of **Rosemarinus officinalis.**

Spirits of Rosemary (Spiritus Rosemarini)	4.0–8.0 c.c.	ʒi–ii

It is used principally as a local application for the skin.

CARYOPHYLUS (Cloves)

The oil of cloves, oleum caryophilis, is the preparation commonly used. It is applied on a piece of cotton for toothache, by inserting the cotton in the cavity of the tooth.

ANISE

This is the fruit of the **Pimpinella anisum,** a European plant.

Oil of Anise (Oleum Anise)	0.3–1.0 c.c.	m. v–xv
Spirits of Anise (Spiritus Anisi)	4.0–8.0 c.c.	ʒi–ii

Anise is an ingredient of the Liquor ammonii anisatus of the German Pharmacopoeia. It is a very commonly used expectorant among German physicians.

JUNIPER (Juniper Berries)

Spirits of Juniper (Spiritus Juniperi)	4.0–8.0 c.c.	ʒi–ii
Compound Spirits of Juniper (Spiritus Juniperi Compositus)	4.0–8.0 c.c.	ʒi–ii

This contains oil of juniper, caraway, and fennel.

Juniper is used to increase the flow of urine.

AMYGDALA AMARA (Bitter Almonds)

This is occasionally used as a carminative.

Bitter almonds contain a glucoside, **amygdalin,** and a ferment, **emulsin.** The action of these substances on one another forms hydrocyanic or prussic acid. This never occurs in the ordinary preparations, but when any of the preparations of bitter almonds are rubbed together with other preparations, prussic acid may be formed. Cases of hydrocyanic acid poisoning have occurred from mixtures which were prepared in this way.

Preparations

Bitter Almond Spirits (Spiritus Amygdalae Amarae)	1.0–4.0 c.c.	m. xv–℥i
Syrup of Bitter Almonds (Syrupus Amygdalae Amarae)	2.0–4.0 c.c.	℥½–i

ERIODICTYON (Yerba Santa)

Eriodictyon is obtained from the leaves of the **Eriodictyon californicum,** or the California tar bush. It is occasionally used as a stimulating expectorant in chronic bronchitis. It lessens the appreciation of bitter tasting substances. It is often used as a vehicle in the form of an elixir, to disguise the taste of bitter drugs, such as quinine.

Preparations

Fluidextract of Yerba Santa (Fluidextractum Eriodycti)	1.0–4.0 c.c.	m. xv–℥i

OTHER FLAVORING SUBSTANCES

Marrubium (Horehound): This is the leaves and tops of the plant. It is used extensively as an expectorant.

Vanilla: This is the unripe fruit of the **Vanilla planifolia.** The tincture of vanilla is the most common official preparation used.

Limonis Cortex, Lemon Peel.
Sassafras, Sassafras Bark.
Foeniculum, Fennel.
Pimenta, Allspice.
Carum, Caraway Seeds.
Myristica, Nutmeg.

The oil, the spirit, and the water are the official preparations of these substances.

Flavoring Compounds

Aromatic Powder (**Pulvis Aromaticus**)	0.3–2.0 gms.	grs. v–xxx

This contains cinnamon, cardamom, nutmeg and ginger, in powder form.

Fluidextract of Aromatic Powder (**Fluidextractum Aromaticus**)	0.5–2.0 c.c.	m. viii–xxx

Aromatic Elixir (**Elixir Aromaticum**) and **Elixir Adjuvans** are preparations of the compound spirits of orange peel used as flavoring agents.

SWEETENING SUBSTANCES

Saccharin (**Benzosulphinidum**): This is a chemical substance which has a very sweet taste. It is 200 times sweeter than sugar and is used to sweeten foods for diabetic patients. It is usually given in 0.03 gm. (gr. $\frac{1}{2}$) doses together with 0.3 gm. (grs. v) of sodium bicarbonate, since it dissolves more readily in alkaline solutions.

Saccharum Lactis (**Milk Sugar**): This is used as a flavoring substance and to give consistency to powders.

CHAPTER XXXV

PRESCRIPTION READING

It is important for the nurse to be able to read prescriptions, as she is occasionally ordered to administer a medicine, the ingredients of which are written in the form of a prescription.

Every prescription consists of four parts:

1. **The Superscription**
2. **The Inscription**
3. **The Subscription**
4. **The Signature**

1. **The superscription** consists of the date, and the name of the patient; which are written at the top, (occasionally the name of the patient is written at the lower right hand corner) and the symbol ℞ which stands for the Latin word RECIPE, meaning "take thou." It is also a symbol of Jupiter, the Grecian god, and is a relic of the days, when all prescriptions were begun with a prayer to him, invoking his divine aid in making the ingredients more efficacious.

2. **The inscription** consists of the names and the amounts of the ingredients used.

The names are written in Latin, usually in the genitive case, for example, Camphora (genitive, Camphorae).

The most important ingredient in the prescription is written first, and is often called the **basis.**

The next most important ingredient is called the **adjuvant,** and is written next.

The next substance on the prescription is usually the one which disguises the taste of the mixture, such as a syrup, and is often called the **corrigent** or **corrective.**

The last substance on the prescription is the one in which

all the others are dissolved, and it is often called the **vehicle, excipient** or **menstruum.**

The quantities of the ingredients are written in the metric or apothecaries' system of measurement.

In the metric system, the units used are the gramme and milligramme.

In the apothecaries' system, the units used are the drachm, grain, minim, etc. They are written in the Arabic symbols, Roman numerals being used however, for the numbers, unless the quantity is a fraction, in which case the Arabic numerals are used.

Example

℥v	=	5 drachms
grs. xx	=	20 grains
℈ix	=	9 scruples
℥i or ℥j	=	1 ounce
♁iii	=	3 pints
℥ss	=	½ drachm
gr. $\frac{1}{100}$	=	$\frac{1}{100}$ grain

The abbreviation ss is for the Latin word semis, meaning half.

3. The **subscription** consists of the directions to the druggist for compounding the prescription. These are usually written in Latin.

Certain abbreviations are commonly used in the subscription. The most common ones are the following:

q. s. = quantum sufficiat (as much as may be necessary)
q. s. ad = quantum sufficiat ad (as much as may be necessary to)
M. = misce (mix)

F. fiat. (singular) used when only one ingredient is written. F. fiant (plural) when many ingredients are used.

F.	= fiat.	= make
D.	= dentur	= give
Div.	= divide	= divide
caps.	= capsulas	= capsule
pil.	= pilulas	= pill
chart.	= chartas	= powder
tab.	= tabellas	= tablet

tab. trit.	= tabellas triturates	= tablet triturates
troch.	= trochiscos	= lozenges
supposit.	= suppositoria	= suppositories
	tales	= such
dos.	= doses	= doses
ad. scat.	= ad scatulam	= in the box
	pone in scat.	= put in a box
	cochleare	= spoon
	cochleare parvum	= teaspoon

The following are the most common Latin verbs used in prescriptions.

adde	= add
bulli	= boil
cola or cōlator	= strain
filtra	= filter
solve	= dissolve
tere	= rub
tere bene	= rub well

The following are the most common adjectives used

	aequalis	= equal
aa.	= partes aequales	= equal parts
	bulliens	= boiled
	fervens	= hot
	saturatus	= saturated
	magnus	= large
	parvus	= small

The **signature** is usually written at the end of the prescription and consists of the directions to the patient. It always begins with the abbreviation S. meaning signa = mark (on the label).

The quantities to be administered are written in the metric or apothecaries' system, for example, a teaspoonful is written 4.0 or ʒi. A dessertspoonful is written 8.0 or ʒii.

The following are the abbreviations used in the signature. It is important for the nurse to know their definitions, as they may be used in her orders.

gtt.	= gutta	= drop
A. M.		= morning
P. M.		= evening
o. d.	= omne die	= daily
o. m.	= omne mane	= every day
o. n.	= omne nocte	= every night
m. et. n.	= mane et nocte	= day and night
t. i. d.	= ter in die	= 3 times a day
b. i. d.	= bis in die	= twice a day
q. i. d.	= quatuor in die	= four times a day (not to be given at night)
q. h.	= quaqua hora	= every hour
q. 2 h.	= quaquae duae horae	= every 2 hours
q. 3 h.	= quaquae tres horae	= every 3 hours

When medicines are ordered to be given q. 2h. or q. 3h etc. they must always be given at night also.

stat.	= statim	= at once, immediately
s. o. s.	= si opus sit	= if necessary

This refers to only one dose. More than one dose should not be given if a medicine is ordered s. o. s.

p. r. n. = pro re nata = when required (as often as necessary)

When a drug is ordered p. r. n. the nurse may use her judgment in giving more than one dose.

a. c.	= ante cibum	= before meals
p. c.	= post cibum	= after meals

At the end of the prescription, the physician's name is signed.

EXAMPLES OF PRESCRIPTIONS OF FLIUD MEDICINES

May 17, 1905

For Mr. John Jones

℞

Magnesii Sulphatis	ʒii
Magnesii Carbonatis	
Spiritus Ammoniae Aromatici āā	ʒi
Aquae q. s. ad.	℥i

M. et. Sig. ʒi t. i. d.

Dr. Brown

In this prescription, the superscription is the ℞ and Mr. John Jones.

The inscription is the mixture of the ingredients, of which the magnesium sulphate is the most important, magnesium carbonate next of importance, while the water is the excipient or menstruum.

The directions to the pharmacist are simply to mix the ingredients together (misce); and the directions to the nurse are to administer one teaspoonful of it three times a day (t. i. d.).

May 5, 1904

For Mr. Bates

℞

Bismuthi Subnitratis	15.0
Mucilaginis Acaciae	10.0
Syrupus Simplicis	5.0
Aquae Cinnamomi q. s. ad.	60.0

Misce et. Sig. ʒi q. i. d.

Dr. Jameston

This prescription reads:

For Mr. Bates.—

Take thou, of bismuth subnitrate 15 grammes, of mucilage of acacia 10 grammes, of simple syrup, 5 grammes, and add enough cinnamon water to make up 60 grammes. Mix the ingredients together and give the patient one teaspoonful of the mixture four times a day.

This is a very good method of prescription writing.

If the mixture is made up in a two ounce bottle, the number of grains of each ingredient, in every teaspoonful, is the same as the number of grammes of each ingredient in the entire mixture; since there are 60 grains in each drachm or teaspoonful dose, and there are 60 grammes in a two ounce bottle.

For Example: In the above prescription we can see at once that each teaspoonful dose of the mixture contains 15 grains of bismuth subnitrate, 10 grains of mucilage of acacia, etc.

EXAMPLES OF PRESCRIPTIONS OF SOLID MEDICINES

Example

June 5, 1900

For Mr. Winsley

℞

Extracti Colocynthidis Compositae ℥ss
Rhei grs. xxiv
m. et divide in pilulas No. XII
Sig. one o. n.

Dr. Jamestain

This prescription reads:

Take thou, of compound extract of colocynth 2 drachms, and of rhubarb 24 grains, mix them together, and divide the mass into twelve pills. Each pill therefore contains $\frac{1}{12}$ of the whole amount, or 10 grains of the compound colocynth powder and 2 grains of the rhubarb.

Example

April 7, 1899

For Mr. Hestar

℞

Tabellarum Morphinae Sulphatis āā 0.015
D. tales dos. No. XX

Dr. Sesley

This prescription reads, take thou of morphine sulphate tablets, each to contain 0.015 (15 milligrammes). Give twenty such doses.

Example

May 17, 1895

For Mr. Hillston

℞

* Pyramidon	0.1
* Phenacetine	0.2
Caffeinae	0.06
Sacchari Lactis	0.3

D. tales dos. No. XX et. pone in scat.
M. et. fiant in chart.
Sig. one t. i. d.

Dr. Lestertan

* These common names are frequently used in prescriptions.

This prescription reads:

Take thou, of pyramidon 1 decigramme, of phenacetine 2 decigrammes, of caffeine 6 centigrammes, and of milk sugar 3 decigrammes. Mix the ingredients together into a powder, and put twenty such powders in a box. Give one powder three times a day.

APPENDIX

THE HARRISON LAW

The Harrison Law went into effect March 1, 1915. It was passed to regulate the sale and use of habit forming drugs such as opium, cocaine or their derivatives so as to prevent the occurrence of the habit. The following are the essential features of the law:

1. Every wholesale and retail druggist who sells opium, cocaine, or their derivatives must be registered annually with the Department of Internal Revenue and pay an annual tax of one dollar. They are permitted to sell any of the substances listed under the law, only upon the written order of a physician, pharmacist or dentist who is also registered with the Department of Internal Revenue. They must keep a record of each sale and give the purchaser a duplicate. All records must be kept for a period of two years and are subject to inspection by officials of the Department of Internal Revenue at any time.

2. Every physician and dentist must be registered with the Department of Internal Revenue and pay an annual tax of one dollar. They must keep a record of the quantities, and drugs obtained, and of their disposal. These records are subject to inspection at any time. Prescriptions calling for any substance listed under the Harrison law must bear the physician's name, address and registry number. They must also contain the patient's name, age and address, and must be dated on the day they are written and signed by the physician ordering them.

3. Any unauthorized person who has any of the substances listed under the law in his possession, is subject to a fine of $2,000 or five years imprisonment or both.

List of Drugs under the Harrison Law

Opium	Coca
Opium Powder	Fluidextract of Coca
Opium tablets (all strengths)	Cocaine
Extract of Opium	Cocaine Hydrochloride
Dover's Powder	Cocaine tablets (all strengths and all combinations)
Tincture of Dover's powder	Codrenin
Tinctura Opii Simplex	Eucaine
Tincture of Deodorized Opium	Holocaine
Morphine Sulphate (all strengths and all tablets)	Novocaine
Magendie's Solution	Tropacocaine
Codeine and its salts	Anaesthesin
Codeine tablets (all strengths)	Orthoform
Dionine (all strengths)	
Codeonal	
Heroin (all tablets and all strengths)	
Papaverine	
Pantopon	
Apomorphine Hydrochloride	
Stypticin	
Styptol	

In addition, all mixtures or prescriptions containing opium, coca, or their derivatives except the following:

1. Preparations that contain less than grs. ii of opium in every ounce.

2. Preparations that contain less than gr. $\frac{1}{4}$ of morphine, gr. i of codeine or gr. $\frac{1}{8}$ of heroin, in every ounce.

3. Liniments or ointments which are used externally, except those containing cocaine or eucaine (alpha or beta), or any of their salts or synthetic substances.

Application of the Harrison Law in Hospitals

Every hospital must be registered with the Department of Internal Revenue and receives a registry number and is subject to same regulations as physicians.

By the following method a record may be kept of the quantities used of the drugs listed under the Harrison law.

1. Substances listed under the Harrison law must be ordered for ward use upon special blanks upon which appears the hospital registry number. All drugs listed in the Harrison law must be ordered on one of these blanks and be signed by a physician.

2. Every order calling for opium, coca, or any of their derivatives must be signed by the physician who orders it, both in the order book and on the chart.

3. A special book should be kept in every ward, in which the nurse enters the name, date, journal number, the dose and the drug given. If a bottle containing any drug listed under the Harrison law is broken, a record of it should also be made. In this book the nurse is therefore able to account for the quantities of Harrison law drugs obtained from the pharmacist.

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Alcohol
Ammonium
Atropine
Caffeine
Camphor
Digitalis
Ephedrine
Pantocain
Strychnine

Aconite
Amyl nitrite
Nitroglycerine
Sweet spirits nitre
Veratrum viride

Alcohol
Ammonium
Atropine
Caffeine
Camphor
Strychnine